

General Aptitude

COMMON TO ALL BRANCHES

**TOPIC WISE GATE SOLUTIONS
2010 - 2026**



GATE ACADEMY®
steps to success...

General Aptitude

Common to All Branches

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GATE ACADEMY Learning Pvt. Ltd.

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To My Son Advait

IMPORTANCE of GATE

GATE examination has been emerging as one of the most prestigious competitive exam for engineers. Earlier it was considered to be an exam just for eligibility for pursuing PG courses, but now GATE exam has gained a lot of attention of students as this exam open an ocean of possibilities like :

1. Admission into IISc, IITs, IIITs, NITs

A good GATE score is helpful for getting admission into IISc, IITs, IIITs, NITs and many other renowned institutions for M.Tech./M.E./M.S. An M.Tech graduate has a number of career opportunities in research fields and education industries. Students get ₹ 12,400 per month as stipend during their course.

2. Selection in various Public Sector Undertakings (PSUs)

A good GATE score is helpful for getting job in government-owned corporations termed as **Public Sector Undertakings (PSUs)** in India like IOCL, BHEL, NTPC, BARC, ONGC, PGCIL, DVC, HPCL, GAIL, SAIL & many more.

3. Direct recruitment to Group A level posts in Central government, i.e., Senior Field Officer (Tele), Senior Research Officer (Crypto) and Senior Research Officer (S&T) in Cabinet Secretariat, Government of India, is now being carried out on the basis of GATE score.

4. Foreign universities through GATE

GATE has crossed the boundaries to become an international level test for entry into postgraduate engineering programmes in abroad. Some institutes in two countries **Singapore** and **Germany** are known to accept GATE score for admission to their PG engineering programmes.

5. National Institute of Industrial Engg. (NITIE)

- NITIE offers **PGDIE / PGDMM / PGDPM** on the basis of GATE scores. The shortlisted candidates are then called for Group Discussion and Personal Interview rounds.
- NITIE offers a Doctoral Level Fellowship Programme recognized by Ministry of HRD (MHRD) as equivalent to Ph.D. of any Indian University.
- Regular full time candidates those who will qualify for the financial assistance will receive ₹ 25,000 during 1st and 2nd year of the Fellowship programme and ₹ 28,000 during 3rd, 4th and 5th year of the Fellowship programme as per MHRD guidelines.

6. Ph.D. in IISc/ IITs

- IISc and IITs take admissions for Ph.D. on the basis of GATE score.
- Earn a Ph.D. degree directly after Bachelor's degree through integrated programme.
- A fulltime residential researcher (RR) programme.

7. Fellowship Program in management (FPM)

- Enrolment through GATE score card
- Stipend of ₹ 22,000 – 30,000 per month + HRA
- It is a fellowship program
- Application form is generally available in month of Sept. and Oct.

Note : In near future, hopefully GATE exam will become a mandatory exit test for all engineering students, so take this exam seriously. Best of LUCK !

GATE Exam Pattern

Section	Question No.	No. of Questions	Marks Per Question	Total Marks
General Aptitude	1 to 5	5	1	5
	6 to 10	5	2	10
Technical + Engineering Mathematics	1 to 25	25	1	25
	26 to 55	30	2	60
Total Duration : 3 hours		Total Questions : 65		Total Marks : 100
Note :				
(i) 40 to 45 marks will be allotted to Numerical Answer Type Questions.				
(ii) MSQ also added from GATE 2021 for which no negative marking.				

Pattern of Questions :

GATE 2026 would contain questions of THREE different types in all the papers :

- (i) **Multiple Choice Questions (MCQ)** carrying 1 or 2 marks each, in all the papers and sections. These questions are objective in nature, and each will have choice of four answers, out of which ONLY ONE choice is correct.

Negative Marking for Wrong Answers : For a wrong answer chosen in a MCQ, there will be negative marking. For 1-mark MCQ, 1/3 mark will be deducted for a wrong answer. Likewise, for 2-mark MCQ, 2/3 mark will be deducted for a wrong answer.

- (ii) **Multiple Select Questions (MSQ)** carrying 1 or 2 marks each in all the papers and sections. These questions are objective in nature, and each will have choice of four answers, out of which ONE or MORE than ONE choice(s) are correct.

Note : There is **NO negative** marking for a wrong answer in MSQ questions. However, there is NO partial credit for choosing partially correct combinations of choices or any single wrong choice.

- (iii) **Numerical Answer Type (NAT)** Questions carrying 1 or 2 marks each in most of the papers and sections. For these questions, the answer is a signed real number, which needs to be entered by the candidate using the virtual numeric keypad on the monitor (keyboard of the computer will be disabled). No choices will be shown for these types of questions. The answer can be a number such as 10 or -10 (an integer only). The answer may be in decimals as well, for example, 10.1 (one decimal) or 10.01 (two decimals) or -10.001 (three decimals). These questions will be mentioned with, up to which decimal places, the candidates need to present the answer. Also, for some NAT type problems an appropriate range will be considered while evaluating these questions so that the candidate is not unduly penalized due to the usual round-off errors. Candidates are advised to do the rounding off at the end of the calculation (not in between steps). Wherever required and possible, it is better to give NAT answer up to a maximum of three decimal places.

Example : If the wire diameter of a compressive helical spring is increased by 2%, the change in spring stiffness (in %) is ____ (correct to two decimal places).

Note : There is NO negative marking for a wrong answer in NAT questions.

Also, there is NO partial credit in NAT questions.

GATE SYLLABUS

COMMON TO ALL PAPERS (BRANCHES) :

Verbal Aptitude :

Basic English grammar: tenses, articles, adjectives, prepositions, conjunctions, verb-noun agreement, and other parts of speech.

Basic vocabulary: words, idioms, and phrases in context Reading and comprehension Narrative sequencing.

Quantitative Aptitude :

Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2 and 3 dimensional plots, maps, and tables.

Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability.

Analytical Aptitude :

Logic: deduction and induction Analogy.

Numerical relations and reasoning.

Spatial Aptitude :

Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping paper folding, cutting, and patterns in 2 and 3 dimensions.

PREFACE

It is our pleasure, that we insist on presenting “**General Aptitude**” authored for **GATE 2027** to all of the aspirants and career seekers. The prime objective of this book is to respond to tremendous amount of ever growing demand for error free, flawless and succinct but conceptually empowered solutions to all the question over the period 2010 - 2026.

This book serves not only as the best supplement for GATE 2027 (Common to All Branches) but shall be useful to a larger extent for other discipline as well.

Simultaneously having its salient features the book comprises :

- ✦ Step by step solution to all questions.
- ✦ Complete analysis of questions, i.e. chapter wise as well as year wise.
- ✦ Detailed explanation of all the questions.
- ✦ Solutions are presented in simple and easily understandable language.
- ✦ It covers all GATE questions from 2010 to 2026 (17 years).

The authors do not sense any deficit in believing that this title will in many aspects, be different from the similar titles within the search of student.

We would like to express our sincere appreciation to **Mrs. Sakshi Dhande Mam** (Director, GATE ACADEMY Learning Pvt. Ltd.) for her constant support and constructive suggestions and comments in reviewing the script.

In particular, we wish to thank **GATE ACADEMY** expert team members for their hard work and consistency while designing the script.

The final manuscript has been prepared with utmost care. However, going a line that, there is always room for improvement in anything done, we would welcome and greatly appreciate the suggestions and corrections for further improvement.

Umesh Dhande

(Director, GATE ACADEMY Learning Pvt. Ltd.)

GATE Paper Codes

Paper Code	Paper Name
AE	Aerospace Engineering
AG	Agricultural Engineering
AR	Architecture and Planning
BM	Biomedical Engineering
BT	Biotechnology
CE	Civil Engineering
CH	Chemical Engineering
CS	Computer Science and Information Technology
CY	Chemistry
EC	Electronics and Communication Engineering
EE	Electrical Engineering
ES	Environmental Science and Engineering
EY	Ecology and Evolution
GG	Geology and Geophysics
IN	Instrumentation Engineering
MA	Mathematics
ME	Mechanical Engineering
MN	Mining Engineering
MT	Metallurgical Engineering
PE	Petroleum Engineering
PH	Physics
PI	Production and Industrial Engineering
ST	Statistics
TF	Textile Engineering and Fibre Science
XE	Engineering Sciences
XH	Humanities and Social Sciences
XL	Life Sciences

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CHAPTER

1

NUMERICAL ABILITY

Contents :

S. No.	Topics	Page No.
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Number System & Series

A number is a tool to measure quantities in real life. Numbers are used in addition, subtraction, multiplication, division, and exponentiation operations. Their study is called **ARITHMETIC**.

CLASSIFICATION OF NUMBERS :

1. **Natural numbers** : Natural numbers are a set of non-negative numbers defined as 0, 1, 2, 3, ... and so on. Natural numbers are also called whole numbers.
2. **Integers** : Integer numbers include all positive numbers, all negative numbers and zero. It can be represented by a set shown below,

$$I = \{\dots, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, \dots\}$$

- (i) **Even and odd numbers** : Any number which is divisible by 2 is considered as even number and any number which is not divisible by 2 is considered as odd number.

Properties of even and odd numbers :

$$\begin{aligned}\text{Even} + \text{Even} &= \text{Even} \\ \text{Odd} + \text{Odd} &= \text{Even} \\ \text{Odd} + \text{Odd} + \text{Odd} &= \text{Odd} \\ \text{Odd} + \text{Even} &= \text{Odd} \\ \text{Even} \times \text{Even} &= \text{Even} \\ \text{Odd} \times \text{Odd} &= \text{Odd} \\ \text{Odd} \times \text{Even} &= \text{Even}\end{aligned}$$

- (ii) **Prime numbers** : Any number which is divisible by either 1 or itself only is called prime number. For example : 2, 3, 5, 7, 11, 13, 17, 19 etc.

Prime number testability :

- a. First take square root of the given number.
- b. Take prime numbers starting from 2 to the obtained square root value or nearest integer.
- c. If the given number is not divisible by any of these prime numbers then the given number is a prime number.

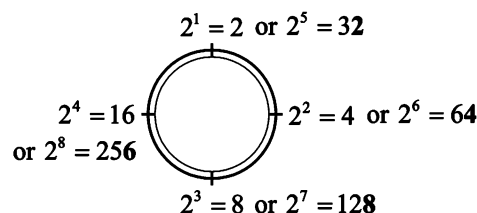
3. **Rational numbers** : Rational numbers are numbers represented as $\frac{a}{b}$ where, a and b are integer numbers and $b \neq 0$.

4. **Complex numbers :** Complex numbers are numbers represented as $a + ib$ where, a and b are real numbers and $i = \sqrt{-1}$.

CYCLICITY :

Cyclicity of a number is used to find unit digit value. Power cycle of a number is defined as highest power of any number such that there is no repetition at its unit digit.

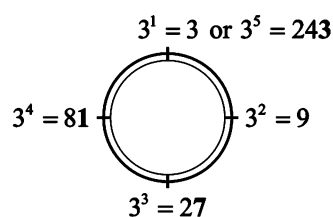
1. Cyclicity of 2 :



Power cycle = 4

Unit digit value = 6

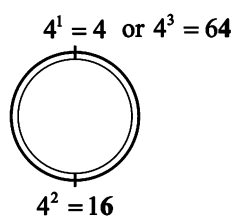
2. Cyclicity of 3 :



Power cycle = 4

Unit digit value = 1

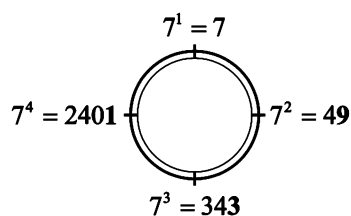
3. Cyclicity of 4 :



Power cycle = 2

Unit digit value = 6

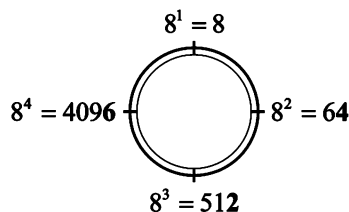
4. Cyclicity of 7 :



Power cycle = 4

Unit digit value = 1

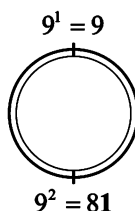
5. Cyclicity of 8 :



Power cycle = 4

Unit digit value = 6

6. Cyclicity of 9 :



Power cycle = 2

Unit digit value = 1

Number	Power cycle	Unit digit value
2	4	6
3	4	1
4	2	6
5	1	5
6	1	6
7	4	1
8	4	6
9	2	1

Example : Find unit digit value of 8^{193} .**Solution :** For to find 8^{193} its power cycle is 4.

and for any number to be divisible by 4 its last two terms should be divisible by 4.

 $193 \longrightarrow$ Last two terms 93

$$\frac{93}{4} = 23 + \frac{1}{4}$$

So we can write it

$$8^{193} = 8^{192} \times 8$$

$$8^{193} = (\text{unit digit of } 8^4) \times 8$$

$$8^{193} = 6 \times 8 = 48$$

So last digit is 8.

FACTORIZATION :

The process of writing a natural number in terms of its prime factors is called factorization.

- Let 'N' be any natural number such that $N = a^p \times b^q \times c^r$ where, a, b and c are prime factors and p, q and r are their respective powers.

- Sum of the factors is given by,

$$S_n = \frac{(a^{p+1} - 1)(b^{q+1} - 1)(c^{r+1} - 1)}{(a - 1)(b - 1)(c - 1)}$$

- Product of factors is given by,

$$P_n = (N)^{\frac{n}{2}}$$

where, n is the number of factors.

- Total number of natural number less than or equal to N and relatively prime to N is given by,

$$N_0 = N \left(1 - \frac{1}{a}\right) \left(1 - \frac{1}{b}\right) \left(1 - \frac{1}{c}\right)$$

- Let $N = a^p b^q c^r$ then the sum of all the natural numbers which are less than or equal to N and relatively prime to N is given by,

$$N_0' = \frac{N}{2} \left[N \left(1 - \frac{1}{a}\right) \left(1 - \frac{1}{b}\right) \left(1 - \frac{1}{c}\right) \right]$$

- The number of ways in which a composite number N may be resolved into two factors,

$$= \frac{1}{2} (p+1)(q+1)(r+1) \cdots; \quad N = a^p b^q c^r \text{ is not a perfect square}$$

$$= \frac{1}{2} [(p+1)(q+1)(r+1) \cdots + 1]; \quad N \text{ is a perfect square}$$

DIVISIBILITY TESTS :

Following are important divisibility tests,

Divisible by	Test	Examples	
2	The unit's digit should be even or 0 (i.e. in the given number at the units place we should have 2, 4, 6, 8, 0)	26, 48 etc.	$6 \div 3 = 2$, $8 \div 2 = 4$
3	The sum of the digits of the number should be divisible by 3.	12729	$(1+2+7+2+9=21)$, $21 \div 3 = 7$
4	The number formed by the last two digits (units' and tens') of the given number should be divisible by 4.	21964	$64 \div 4 = 16$

5	The unit's digit should be 0 or 5.	1835, 15440	Last digits are 5 and 0 respectively
6	The sum of the digits of the number should be divisible by 3 and the number should be even	1272	$(1+2+7+2 = 12)$, $12 \div 3 = 4$, Number is even
8	The number formed by the last three digits (units', tens' and hundreds') of the given number should be divisible by 8.	52672	$672 \div 8 = 84$
9	The sum of the digits of the number should be divisible by 9.	127296	$(1+2+7+2+9+6 = 27)$, $27 \div 9 = 3$
10	The unit's digit should be 0.	3220	Unit's digits is zero.
11	The difference between the sum of digits in the even and odd places should be zero or a multiple of 11.	54043	$5+0+3 = 4+4 = 8$, Hence difference is zero.
12	The sum of the digits of the number should be divisible by 3 and last 2 digits (unit's and ten's) also be divisible by 4.	1728	$(1+7+2+8=18)$ $18 \div 3=6$, Also $28 \div 4 = 7$
15	The sum of the digits of the number should be divisible by 3 and unit's digit of the number should be 0 or 5.	810645	$(8+1+0+6+4+5 = 24)$, $24 \div 3 = 8$, also last digits is 5.
16	The number formed by the last four digits (units', tens' hundreds' and thousands') of the given number should be divisible by 16.	12978320	$8320 \div 16 = 520$
25	The last three number of the digits of the number should be 125, 250, 375, 500, 625, 750, 875, or 000.	1125, 1875, 15500, 35625, 76375, 22250, 49750, 5000	The last three digits are as required.

1. Divisible test for 7

The test holds good only for numbers with more than three digits and is applied as follows,

- Group the number in sets of three from the unit's digit.
- Add the odd groups and the even groups separately.
- The difference of the odd and the even groups should be either 0 or divisible by 7.

Example : Is 85437954 divisible by 7?

Dividing the given number in three sets,

$$\underline{85} \quad \underline{437} \quad \underline{954}$$

Adding up the first and the third sets, we get

$$85 + 954 = 1039$$

Now their difference is $1039 - 437 = 602$.

Since, $602 \div 7 = 86$

Hence the number is divisible by 7.

2. Divisibility test for 13

The test holds good only for numbers with more than three digits. The test to be applied is as follows,

1. Group the numbers in sets of three from the unit's digit.
2. Add the odd groups and the even separately.
3. The difference of the odd and the even group should be either 0 or divisible by 13.

Example : Is 136999005 divisible by 13?

Dividing the given number in three sets,

$$136 \quad 999 \quad 005$$

Adding up the first and the third sets, we get

$$136 + 5 = 141.$$

Now their difference is $999 - 141 = 858$

Since, $858 \div 13 = 66$

Hence, the number is divisible by 13.

FORMULAE :

1. $a^2 - b^2 = (a + b)(a - b)$
2. $a^2 + 2ab + b^2 = (a + b)^2$
3. $a^2 - 2ab + b^2 = (a - b)^2$
4. $(a + b)^2 - (a - b)^2 = 4ab$
5. $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + ac + bc)$
6. $x^2 + (a + b)x + ab = (x + a)(x + b)$
7. $ac + bc + ad + bd = c(a + b) + d(a + b) = (a + b)(c + d)$
8. $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$
9. $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$
10. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

11. $a^3 + b^3 = (a+b)^3 - 3ab(a+b)$
12. $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$
13. $a^3 - b^3 = (a-b)^3 + 3ab(a-b)$
14. $a^3 + b^3 + c^3 - 3abc = (a+b+c)(a^2 + b^2 + c^2 - ab - bc - ca)$
15. $a^3 + b^3 + c^3 - 3abc = \frac{1}{2}(a+b+c) \left[(a+b)^2 + (b-c)^2 + (c-a)^2 \right]$
16. If $a + b + c = 0$ or $a = b = c$
then $a^3 + b^3 + c^3 = 3abc$ or $\frac{a^2}{bc} + \frac{b^2}{ca} + \frac{c^2}{ab} = 3$
17. $a^n + b^n = (a+b)(a^{n-1} - a^{n-2}b + a^{n-3}b^2 - \dots)$ here n should be odd only
18. $a^n - b^n = (a-b)(a^{n+1} + a^{n+2}b + a^{n+3}b^2 + \dots)$
19. For determining the coefficients of the terms in the expansion of $(x+a)^n$, for any positive integer n , we can use the Pascal's triangle, which is explained below.

Power	Coefficients
$n=0$	1
$n=1$	1 1
$n=2$	1 2 1
$n=3$	1 3 3 1
$n=4$	1 4 6 4 1
$n=5$	1 5 10 10 5 1
$n=6$	1 6 15 20 15 6 1

Example : For $n = 4$,

In the expansion of $(x+a)^4$ the fourth coefficient will be 4 (from Pascal's triangle)

PROGRESSION :

Progression is a series consisting of terms that has a certain pattern and due to which they are predictable. Progression in mathematics is of three types as given below,

1. **Arithmetic Progression :** By an arithmetic progression of n terms, we mean a finite sequence of the form $a, a+d, a+2d, a+3d, \dots, a+(n-1)d$.

where, a is called the first term of the arithmetic progression and d is called the common difference of the arithmetic progression.

The n^{th} term in the arithmetic progression is given by,

$$T_n = a + (n-1)d$$

Sum of an arithmetic progression :

The sum of the n terms of an arithmetic progression with first term a and common difference d is given by,

$$S = \frac{n}{2} [2a + (n-1)d] = \frac{n}{2} (a+l)$$

Where l = last term of the series

Important points :

- (i) If three numbers are in AP then it can be assumed that these numbers are $(a-d)$, a , $(a+d)$
- (ii) If four numbers are in AP then it can be assumed that these numbers are $(a-3d)$, $(a-d)$, $(a+d)$, $(a+3d)$.
- (iii) If five numbers are in AP then it can be assumed that these numbers are $(a-2d)$, $(a-d)$, a , $(a+d)$, $(a+2d)$.
- (iv) Arithmetic mean is given by,

$$AM = \frac{a+b}{2} \quad (\text{for two terms})$$

$$AM = \frac{a+b+c+\dots n \text{ terms}}{n}$$

- (v) If the same quantity be added to, or subtracted from all the terms of an AP, the resulting terms will form an AP, but with the same common difference as before.
- (vi) If all the terms of an AP be multiplied or divided by the same quantity, the resulting terms will form an AP, but with a new common difference, which will be the multiplication / division of the old common difference.

2. **Geometric Progression :** In Geometric progression, every term is obtained by multiplying the previous term with a fixed value. Geometric series is given by,

$$a, ar, ar^2, ar^3 \dots$$

Where, a is the first term and r is the common ratio.

The n^{th} term in the GP series is given by,

$$T_n = ar^{n-1}$$

Sum of geometric progression :

The sum of the n terms of an geometric progression with first term a and common ratio r is given by,

$$S = a \left(\frac{r^n - 1}{r - 1} \right); \quad r > 1$$

$$S = a \left(\frac{1 - r^n}{1 - r} \right); \quad r < 1$$

Sum of infinite geometric progression series :

$$S = \frac{a}{1-r}; \quad r < 1$$

$$S = \infty; \quad r > 1$$

Important points :

- (i) If three numbers are in GP then it can be assumed that these numbers are $\frac{a}{r}, a, ar$
- (ii) If four numbers are in GP then it can be assumed that these numbers are $\frac{a}{r^3}, \frac{a}{r}, ar, ar^3$.
- (iii) Geometric mean is given by,

$$GM = \sqrt{ab} \quad (\text{for two terms})$$

$$GM = (a \times b \times c \cdots n \text{ terms})^{1/n}$$

- (iv) If all the terms of a GP be multiplied or divided by the same quantity, the resulting terms will form a GP with the same common ratio as before.
- (v) If $a, b, c, d, \dots$ are in GP, there is also continued proportion, since, by definition, $a/b = b/c = c/d = \dots = 1/r$

- 3. Harmonic Progression :** In harmonic progression, every term represents inverse of every term present in arithmetic progression. If 2, 4, 6, 8.... is an arithmetic series then harmonic series is given as $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}, \dots$.

The n^{th} term of a harmonic series is calculated by,

- (i) Inverse all the terms of the series.
- (ii) Calculate the n^{th} term using arithmetic progression formula.
- (iii) Inverse the obtained n^{th} term.

Harmonic mean is given by,

$$HM = \frac{2ab}{a+b} \quad (\text{for two terms})$$

SHORTCUTS :

- (i) To find the sum of the first n natural numbers :

Let the sum be denoted by S then,

$$S = 1 + 2 + 3 + \dots + n, \text{ is given by,}$$

$$S = \frac{n(n+1)}{2}$$

- (ii) To find the sum of the squares of the first n natural numbers :

Let the sum be denoted by S then,

$$S = 1^2 + 2^2 + 3^2 + \dots + n^2$$

This is given by,

$$S = \left\{ \frac{n(n+1)(2n+1)}{6} \right\}$$

- (iii) To find the sum of the cubes of the first n natural numbers :

Let the sum be denoted by S then,

$$S = 1^3 + 2^3 + 3^3 + \dots + n^3$$

$$S = \left[\frac{n(n+1)}{2} \right]^2$$

Thus, the sum of the cubes of the first n natural numbers is equal to the square of the sum of these numbers.

- (iv) To find the sum of the first n odd natural numbers :

$$S = 1 + 3 + 5 + \dots + (2n-1) = n^2$$

- (v) To find the sum of the first n even natural numbers.

$$S = 2 + 4 + 6 + \dots + 2n = n(n+1) = n^2 + n$$

- (vi) To find the sum of odd numbers $\leq n$, where n is a natural number :

Case A : If n is odd $\rightarrow [(n+1)/2]^2$

Case B : If n is even $\rightarrow [n/2]^2$

- (vii) To find the sum of even numbers $\leq n$, where n is a natural number :

Case A : If n is odd $\rightarrow \left\{ \left(\frac{n}{2} \right) \left[\left(\frac{n}{2} \right) + 1 \right] \right\}$

Case B : If n is even $\rightarrow \left[\left(\frac{n-1}{2} \right) \left(\frac{n+1}{2} \right) \right]$

- (viii) If A , G , H be the arithmetic, geometric and harmonic means between any two quantities respectively then $A > G > H$.



2010 IIT Guwahati

- 1.1** If $137 + 276 = 435$ how much is $731 + 672$? [All branches]
 (A) 534 (B) 1403
 (C) 1623 (D) 1513
- 1.2** Given digits 2, 2, 3, 3, 3, 4, 4, 4, 4. How many distinct 4 digit numbers greater than 3000 can be formed?
 [All branches]
 (A) 50 (B) 51
 (C) 52 (D) 54
- 1.3** Consider the series
 $\frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{8} + \frac{1}{9} - \frac{1}{16} + \frac{1}{32} + \frac{1}{27} - \frac{1}{64} + \dots$
 The sum of the infinite series above is :
 [TF]
 (A) ∞ (B) $\frac{5}{6}$
 (C) $\frac{1}{2}$ (D) 0
- 1.4** Given the sequence A, B, B, C, C, C, D, D, D, D, ... etc., that is one A, Two Bs, three Cs, four Ds, five Es and so on, the 240th letter in the sequence will be :
 [MN]
 (A) V (B) U
 (C) T (D) W
- 1.5** Consider the set of integers $\{1, 2, 3, \dots, 5000\}$. The number of integers that is divisible by neither 3 nor 4 is : [MN]
 (A) 1668 (B) 2084
 (C) 2500 (D) 2916
- 1.6** A positive integer m in base 10 when represented in base 2 has the representation p and in base 3 has the representation q . We get $p - q = 990$, where the subtraction is done in base 10.

Which of the following is necessarily true : [MN]

- (A) $m \geq 14$ (B) $9 \leq m \leq 13$
 (C) $6 \leq m \leq 8$ (D) $m < 6$

2011 IIT Madras

- 1.7** The sum of n terms of the series $4 + 44 + 444 + \dots$ is
 [AG, CY, EC, EE, IN, MA, MT, XE, XL]
 (A) $\left(\frac{4}{81}\right)[10^{n+1} - 9n - 1]$
 (B) $\left(\frac{4}{81}\right)[10^{n-1} - 9n - 1]$
 (C) $\left(\frac{4}{81}\right)[10^{n+1} - 9n - 10]$
 (D) $\left(\frac{4}{81}\right)[10^n - 9n - 10]$
- 1.8** Three friends R , S and T shares toffee from a bowl. R took $\frac{1}{3}$ rd of the toffees, but returned four to the bowl. S took $\frac{1}{4}$ th of what was left but returned three toffees to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?
 [AG, CY, EC, EE, IN, MA, MT, XE, XL]
 (A) 38 (B) 31
 (C) 48 (D) 41
- 2012 IIT Delhi**
- 1.9** If $(1.001)^{1259} = 3.52$ and $(1.001)^{2062} = 7.85$, then $(1.001)^{3321} =$
 [CY, EC, EE, IN, MA, MT, XE, XL]
 (A) 2.23 (B) 4.33
 (C) 11.37 (D) 27.64

- 1.10** Raju has 14 currency notes in his pocket consisting of only Rs. 20 notes and Rs. 10 notes. The total money value of the notes is Rs. 230. The number of Rs. 10 notes that Raju has is

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) 5 (B) 6
(C) 9 (D) 10

- 1.11** There are eight bags of rice looking alike, seven of which have equal weight and one is slightly heavier. The weighing balance is of unlimited capacity. Using this balance, the minimum number of weighings required to identify the heavier bag is

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) 2 (B) 3
(C) 4 (D) 8

- 1.12** A value of x that satisfies the equation $\log x + \log(x-7) = \log(x+11) + \log 2$ is

[AR, GG, TF]

- (A) 1 (B) 2
(C) 7 (D) 11

- 1.13** The arithmetic mean of five different natural numbers is 12. The largest possible value among the numbers is :

[AE, AG, MN]

- (A) 12 (B) 40
(C) 50 (D) 60

- 1.14** If a prime number on division by 4 gives a remainder of 1, then that number can be expressed as [AE, AG, MN]

- (A) sum of squares of two natural numbers
(B) sum of cubes of two natural numbers
(C) sum of square roots of two natural numbers
(D) sum of cube roots of two natural numbers

2013 IIT Bombay

- 1.15** In the summer of 2012, in New Delhi, the mean temperature of Monday to Wednesday was 41°C and of Tuesday to Thursday was 43°C . If the temperature on Thursday was 15% higher than that of Monday, then the temperature in $^{\circ}\text{C}$ on Thursday was [EC, EE, IN]

- (A) 40 (B) 43
(C) 46 (D) 49

- 1.16** Find the sum to n terms of the series $10 + 84 + 734 + \dots$ [EC, EE, IN]

- (A) $\frac{9(9^n + 1)}{10} + 1$ (B) $\frac{9(9^n - 1)}{8} + 1$
(C) $\frac{9(9^n - 1)}{8} + n$ (D) $\frac{9(9^n - 1)}{8} + n^2$

- 1.17** What will be the maximum sum of 44, 42, 40, ...? [CS, ME, PI]

- (A) 502 (B) 504
(C) 506 (D) 500

- 1.18** Find the sum of the expression

$$\frac{1}{\sqrt{1} + \sqrt{2}} + \frac{1}{\sqrt{2} + \sqrt{3}} + \frac{1}{\sqrt{3} + \sqrt{4}} + \dots + \frac{1}{\sqrt{80} + \sqrt{81}}$$

[CS, ME, PI]

- (A) 7 (B) 8
(C) 9 (D) 10

- 1.19** A number is as much greater than 75 as it is smaller than 117. The number is

[AR, CE, GG, MA, MT, PH, TF]

- (A) 91 (B) 93
(C) 89 (D) 96

2014 IIT Kharagpur

- 1.20** Fill in the missing number in the series.

2 3 6 15 _____ 157.5 630

[EC-2, ME-2]

- 1.21** At what time between 6 am and 7 am will the minute hand and hour hand of a clock make an angle closest to 60° ?
[CS-2, EE-2]
(A) 6:22 am (B) 6:27 am
(C) 6:38 am (D) 6:45 am
- 1.22** What is the next number in the series?
12 35 81 173 357 ____
[EC-1, ME-1]
- 1.23** Find the odd one from the following group :
[EC-1, ME-1]

<i>W, E, K, O</i>	<i>I, Q, W, A</i>
<i>F, N, T, X</i>	<i>N, V, B, D</i>
(A) <i>W, E, K, O</i>	(B) <i>I, Q, W, A</i>
(C) <i>F, N, T, X</i>	(D) <i>N, V, B, D</i>
- 1.24** Find the odd one in the following group

<i>Q, W, Z, B</i>	<i>B, H, K, M</i>
<i>W, C, G, J</i>	<i>M, S, V, X</i>

[EC-2, ME-2]

(A) <i>Q, W, Z, B</i>	(B) <i>B, H, K, M</i>
(C) <i>W, C, G, J</i>	(D) <i>M, S, V, X</i>
- 1.25** The sum of eight consecutive odd numbers is 656. The average of four consecutive even numbers is 87. What is the sum of the smallest odd number and second largest even number?
[EC-2, ME-2]
- 1.26** The next term in the series is 81, 54, 36, 24 ____?
[EC-3, ME-3]
- 1.27** In which of the following options will be expression $P < M$ be definitely true?
[EC-3, ME-3]

(A) $M < R > P > S$
(B) $M > S < P < F$
(C) $Q < M < F = P$
(D) $P = A < R < M$
- 1.28** Find the next term in the sequence :
7G, 11K, 13M, ____ [EC-3, ME-3]
(A) 15Q (B) 17Q
(C) 15P (D) 17P
- 1.29** In a sequence of 12 consecutive odd numbers, the sum of the first 5 numbers is 425. What is the sum of the last 5 numbers in the sequence?
[EC-4, ME-4]
- 1.30** Find the next term in the sequence :
13M, 17Q, 19S, ____
[EC-4, ME-4]
(A) 21W (B) 21V
(C) 23W (D) 23V
- 1.31** A five digit number is formed using the digits 1,3,5,7 and 9 without repeating any of them. What is the sum of all such possible five digit numbers?
[EC-4, ME-4]
(A) 6666660 (B) 6666600
(C) 6666666 (D) 6666606
- 1.32** If $\left(z + \frac{1}{z}\right)^2 = 98$, compute $\left(z^2 + \frac{1}{z^2}\right)$.
[CS-1, EE-1]
- 1.33** What is the average of all multiples of 10 from 2 to 198?
[CS-2, EE-2]
(A) 90 (B) 100
(C) 110 (D) 120
- 1.34** The value of $\sqrt{12 + \sqrt{12 + \sqrt{12 + \dots}}}$ is
[CS-2, EE-2]
(A) 3.464 (B) 3.932
(C) 4.000 (D) 4.444
- 1.35** Which number does not belong in the series below?
[CS-3, EE-3]
2, 5, 10, 17, 26, 37, 50, 64
(A) 17 (B) 37
(C) 64 (D) 26

- 1.36 Consider the equation,

$$(7526)_8 - (Y)_8 = (4364)_8$$

Where $(X)_N$ stands for X to the base N .

Find Y . [CS-3, EE-3]

- (A) 1634 (B) 1737
(C) 3142 (D) 3162

- 1.37 Find the odd one in the following group

[AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

ALRVX, EPVZB, ITZDF, OYEIK

- (A) ALRVX (B) EPVZB
(C) ITZDF (D) OYEIK

2015 IIT Kanpur

- 1.38 Find the missing sequence in the letter series below : [EC-3, ME-2]

A, CD, GHI, ?, UVWXY

- (A) LMN (B) MNO
(C) MNOP (D) NOPQ

- 1.39 If the list of letters, P, R, S, T, U is an arithmetic sequence, which of the following are also in arithmetic sequence? [CS-2, EE-2]

I. $2P, 2R, 2S, 2T, 2U$

II. $P - 3, R - 3, S - 3, T - 3, U - 3$

III. P^2, R^2, S^2, T^2, U^2

- (A) I only (B) I and II
(C) II and III (D) I and III

- 1.40 If $\log_x(5/7) = -1/3$, then the value of x is

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]

- (A) $343/125$ (B) $125/343$
(C) $-25/49$ (D) $-49/25$

- 1.41 Operators $\square$, $\diamond$ and $\rightarrow$ are defined by :

$$a \square b = \frac{a-b}{a+b};$$

$$a \diamond b = \frac{a+b}{a-b};$$

$$a \rightarrow b = ab$$

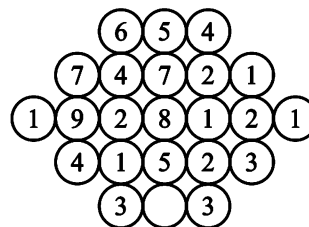
Find the value of $(66 \square 6) \rightarrow (66 \diamond 6)$

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]

- (A) -2 (B) -1
(C) 1 (D) 2

- 1.42 Fill in the missing value

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]



- 1.43 If $a^2 + b^2 + c^2 = 1$, then $ab + bc + ac$ lies in the interval [EC-2, ME-1]

- (A) $[1, 2/3]$ (B) $[-1/2, 1]$
(C) $[-1, 1/2]$ (D) $[2, -4]$

- 1.44 If $x > y > 1$, which of the following must be true?

(i) $\ln x > \ln y$

(ii) $e^x > e^y$

(iii) $y^x > x^y$

(iv) $\cos x > \cos y$ [EC-3, ME-2]

- (A) (i) and (ii) (B) (i) and (iii)
(C) (iii) and (iv) (D) (ii) and (iv)

- 1.45 $\log \tan 1^\circ + \log \tan 2^\circ + \dots + \log \tan 89^\circ$ is _____ [EC-3, ME-2]

- (A) 1 (B) $\frac{1}{\sqrt{2}}$

(C) 0 (D) -1

- 1.46 How many four digit numbers can be formed with the 10 digits 0, 1, 2, ...9 if no number can start with 0 and if repetitions are not allowed? [CE-2]

2016 IISc Bangalore

- 1.47 If $q^{-a} = \frac{1}{r}$ and $r^{-b} = \frac{1}{s}$ and $s^{-c} = \frac{1}{q}$, the value of abc is _____.

[EC-1, ME-1]

- (A) $(rqs)^{-1}$ (B) 0
(C) 1 (D) $r + q + s$
- 1.48** Given $(9 \text{ inches})^{1/2} = (0.25 \text{ yards})^{1/2}$, which one of the following statements is **TRUE**? [EC-2, ME-3]
(A) 3 inches = 0.5 yards
(B) 9 inches = 1.5 yards
(C) 9 inches = 0.25 yards
(D) 81 inches = 0.0625 yards
- 1.49** Two and a quarter hours back, when seen in a mirror, the reflection of a wall clock without number markings seemed to show 1:30. What is the actual current time shown by the clock? [EC-2, ME-3]
(A) 8 : 15 (B) 11 : 15
(C) 12 : 15 (D) 12 : 45
- 1.50** The number that least fits this set: (324, 441, 97 and 64) is [AR, CY, EC-3, IN, MA, PE]
(A) 324 (B) 441
(C) 97 (D) 64
- 1.51** Pick the odd one out in the following : 13, 23, 33, 43, 53 [AE, EE-2, TF, XE, XL]
(A) 23 (B) 33
(C) 43 (D) 53
- 1.52** If $|9y - 6| = 3$, then $y^2 - 4y/3$ is [AE, EE-2, TF, XE, XL]
(A) 0 (B) $+1/3$
(C) $-1/3$ (D) undefined
- 1.53** The numeral in the units position of $211^{870} + 146^{127} \times 3^{424}$ is _____. [AE, EE-2, TF, XE, XL]
- 1.54** The sum of the digits of a two-digit number is 12. If the new number formed by reversing the digits is greater than the original number by 54, find the original number. [AG, CE-2, EY, MT, PI]

- (A) 39 (B) 57
(C) 66 (D) 93

2017 IIT Roorkee

- 1.55** The number of 3 digit numbers such that the digit 1 is never to the immediate right of 2 is [AE, EC-2, MA, MT, PE, PH]
(A) 781 (B) 791
(C) 881 (D) 891
- 1.56** Find the smallest number y such that $y \times 162$ is a perfect cube. [CS-1, EE-1]
(A) 24 (B) 27
(C) 32 (D) 36
- 1.57** The probability that a k -digit number does NOT contain the digits 0, 5 or 9 is [CS-1, EE-1]
(A) 0.3^k (B) 0.6^k
(C) 0.7^k (D) 0.9^k
- 1.58** X is a 30 digit number starting with the digit 4 followed by the digit 7. Then the number X^3 will have, [CS-2, EE-2]
(A) 90 digits (B) 91 digits
(C) 92 digits (D) 93 digits
- 1.59** What is the value of x when

$$81 \times \left(\frac{16}{25}\right)^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$$
[CE-2, IN, XE, XL]
(A) 1
(B) -1
(C) -2
(D) Cannot be determined
- 1.60** What is the sum of the missing digits in the subtraction problem below? [AR, ME-1, TF]
- $$\begin{array}{r} 5 \_ \_ \_ \_ \\ -48 \_ 89 \\ \hline 1 \ 1 \ 1 \end{array}$$
- (A) 8 (B) 10
(C) 11
(D) Cannot be determined

- 1.61** If a and b are integers and $a - b$ is even, which of the following must always be even? [AG, GG, ME-2]

(A) ab (B) $a^2 + b^2 + 1$
(C) $a^2 + b + 1$ (D) $ab - b$

- 1.62** The last digit of $(2171)^7 + (2172)^9 + (2173)^{11} + (2174)^{13}$ is [CE-1, CH, MN]

(A) 2 (B) 4
(C) 6 (D) 8

2018 IIT Guwahati

- 1.63** If the number 715 ■ 423 is divisible by 3 (■ denotes the missing digit in the thousand's place), then the smallest whole number in the place of ■ is _____. [EC]

(A) 0 (B) 2
(C) 5 (D) 6

- 1.64** What is the value of [EC]

$$1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \frac{1}{256} + \dots?$$

(A) 2 (B) $\frac{7}{4}$
(C) $\frac{3}{2}$ (D) $\frac{4}{3}$

- 1.65** For what values of k given below is $\frac{(k+2)^2}{k-3}$ an integer? [EE]

(A) 4, 8, 18 (B) 4, 10, 16
(C) 4, 8, 28 (D) 8, 26, 28

- 1.66** Given that a and b are integers and $a + a^2b^3$ is odd then, which one of the following statements is correct?

[EY, ME-1, PE, XE, XL]

(A) a and b are both odd
(B) a and b are both even
(C) a is even and b is odd
(D) a is odd and b is even

- 1.67** A number consists of two digits, the sum of digits is 9. If 45 is subtracted from the number, its digits are interchanged. What is the number? [EY, ME-1, PE, XE, XL]

(A) 63 (B) 72
(C) 81 (D) 90

- 1.68** Find the missing group of letters in the following series : BC, FGH, LMNO, _____. [AE, MA, ME-2, PI]

(A) UVWXY (B) TUVWX
(C) STUVW (D) RSTUV

- 1.69** Consider a sequence of numbers $a_1, a_2, a_3, \dots, a_n$ where $a_n = \frac{1}{n} - \frac{1}{n+2}$, for each integer ($n > 0$). What is the sum of the first 50 terms? [CE-1]

(A) $\left(1 + \frac{1}{2}\right) - \frac{1}{50}$ (B) $\left(1 + \frac{1}{2}\right) + \frac{1}{50}$
(C) $\left(1 + \frac{1}{2}\right) - \left(\frac{1}{51} + \frac{1}{52}\right)$
(D) $1 - \left(\frac{1}{51} + \frac{1}{52}\right)$

- 1.70** For non-negative integers, a, b, c , what would be the value of $a + b + c$ if $\log a + \log b + \log c = 0$? [CE-2]

(A) 3 (B) 1
(C) 0 (D) -1

- 1.71** $\frac{a + a + a + \dots + a}{n \text{ times}} = a^2b$ and

$$\frac{b + b + b + \dots + b}{m \text{ times}} = ab^2, \text{ where } a, b, n$$

and m are natural numbers. What is the

value of $\left(\frac{m + m + m + \dots + m}{n \text{ times}}\right)$

$\left(\frac{n + n + n + \dots + n}{m \text{ times}}\right)$? [CE-2]

- (A) $2a^2b^2$ (B) a^4b^4
 (C) $ab(a+b)$ (D) a^2+b^2
- 1.72** A faulty wall clock is known to gain 15 minutes every 24 hours. It is synchronized to the correct time at 9 AM on 11th July. What will be the correct time to the nearest minute when the clock shows 2 PM on 15th July of the same year? [CE-2]
 (A) 12:45 PM (B) 12:58 PM
 (C) 1:00 PM (D) 2:00 PM
- 1.73** If $pqr \neq 0$ and $p^{-x} = \frac{1}{q}$, $q^{-y} = \frac{1}{r}$, $r^{-z} = \frac{1}{p}$, what is the value of the product xyz ? [CS, MN]
 (A) -1 (B) $\frac{1}{pqr}$
 (C) 1 (D) pqr
- 1.74** What would be the smallest natural number which when divided either by 20 or by 42 or by 76 leaves a remainder of 7 in each case? [CS, MN]
 (A) 3047 (B) 6047
 (C) 7987 (D) 63847
- 1.75** What is the missing number in the following sequence? [CS, MN]
 2, 12, 60, 240, 720, 1440, _____, 0
 (A) 2880 (B) 1440
 (C) 720 (D) 0
- 1.76** In appreciation of the social improvements completed in a town, a wealthy philanthropist decided to gift Rs 750 to each male senior citizen in the town and Rs 1000 to each female senior citizen. Altogether, there were 300 senior citizens eligible for this gift. However, only 8/9th of the eligible men and 2/3rd

of the eligible women claimed the gift. How much money (in Rupees) did the philanthropist give away in total?

[CS, MN]

- (A) 1,50,000 (B) 2,00,000
 (C) 1,75,000 (D) 1,51,000

2019 IIT Madras

- 1.77** On a horizontal ground, the base of a straight ladder is 6 m away from the base of a vertical pole. The ladder makes an angle of 45° to the horizontal. If the ladder is resting at a point located at one – fifth of the height of the pole from the bottom, the height of the pole is _____ meters. [CE-1]
 (A) 15 (B) 25
 (C) 35 (D) 30
- 1.78** Two design consultants, P and Q, started working from 8 AM for a client. The client budgeted a total of USD 3000 for the consultants. P stopped working when hour hand moved by 210 degrees on the clock. Q stopped working when the hour hand moved by 240 degrees. P took two tea breaks of 15 minutes each during her shift, but took no lunch break. Q took only one lunch break for 20 minutes, but no tea breaks. The market rate for consultants is USD 200 per hour and breaks are not paid. After paying the consultants, the client shall have USD _____ remaining in the budget. [EC]
 (A) 000.00 (B) 300.00
 (C) 166.67 (D) 433.33
- 1.79** Given two sets $X = \{1, 2, 3\}$ and $Y = \{2, 3, 4\}$, we construct a set Z of all possible fractions where the numerators belong to set X and the denominators belong to set Y . The product of elements having

- minimum and maximum values in the set Z is _____. [EE]
- (A) $1/8$ (B) $3/8$
(C) $1/12$ (D) $1/6$
- 1.80** The missing number in the given sequence 343, 1331, _____, 4913 is [EE]
- (A) 4096 (B) 2744
(C) 2197 (D) 3375
- 1.81** How many integers are there between 100 and 1000 all of whose digits are even? [EE]
- (A) 90 (B) 100
(C) 80 (D) 60
- 1.82** Five numbers 10, 7, 5, 4 and 2 are to be arranged in a sequence from left to right following the directions given below:
1. No two odd or even numbers are next to each other.
 2. The second number from the left is exactly half of the left-most number.
 3. The middle number is exactly twice the right-most number.
- Which is the second number from the right?
- [AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]
- (A) 2 (B) 4
(C) 7 (D) 10

2020 IIT Delhi

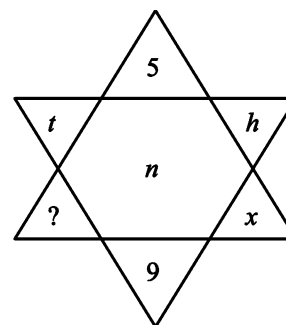
- 1.83** It is quarter past three in your watch. The angle between the hour hand and the minute hand is _____. [AE, AG, EC, GG]
- (A) 22.5° (B) 15°
(C) 7.5° (D) 0°
- 1.84** In four-digit integer numbers from 1001 to 9999, the digit group "37" (in the same sequence) appears _____ times. [EE, EY, TF]

- (A) 270 (B) 299
(C) 279 (D) 280

- 1.85** The sum of the first n terms in the sequence 8, 88, 888, 8888, ... is _____. [IN, ME-1, MT, PE, PH]

- (A) $\frac{81}{80}(10^n - 1) + \frac{9}{8}n$
(B) $\frac{81}{80}(10^n - 1) - \frac{9}{8}n$
(C) $\frac{80}{81}(10^n - 1) + \frac{8}{9}n$
(D) $\frac{80}{81}(10^n - 1) - \frac{8}{9}n$

- 1.86** Find the missing element in the following figure. [CY, ME-2, PI]



- (A) e (B) y
(C) d (D) w

- 1.87** Insert seven numbers between 2 and 34, such that the resulting sequence including 2 and 34 is an arithmetic progression. The sum of these inserted seven numbers is _____. [CE-1]
- (A) 130 (B) 120
(C) 124 (D) 126
- 1.88** The difference between the sum of the first $2n$ natural numbers and the sum of the first n odd numbers is [AR, BM, BT, CH, MA, MN, ST, XE, XL]
- (A) $2^n - n$ (B) $n^2 - n$
(C) $2^n + n$ (D) $n^n + n$

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- 1.89 p and q are positive integers and

$$\frac{p}{q} + \frac{q}{p} = 3, \text{ then, } \frac{p^2}{q^2} + \frac{q^2}{p^2} =$$

[EC, ES, PE, PI, ST]

- (A) 7 (B) 11
(C) 9 (D) 3

- 1.90 Which one of the following numbers is exactly divisible by $(11^{13} + 1)$?

[AG, EE, EY, GG]

- (A) $11^{26} + 1$ (B) $11^{52} - 1$
(C) $11^{39} - 1$ (D) $11^{33} + 1$

- 1.91 Let $\oplus$ and $\odot$ are two operators on numbers p and q such that

$$p \oplus q = \frac{p^2 + q^2}{pq} \text{ and } p \odot q = \frac{p^2}{q},$$

if $x \oplus y = 2 \odot 2$, then x : [CE-1, CY, IN]

- (A) y (B) $2y$
(C) $\frac{y}{2}$ (D) $\frac{3y}{2}$

- 1.92 $\oplus$ and $\odot$ are two operators on numbers p and q such that $p \odot q = p - q$ and $p \oplus q = p \times q$. Then

$$(9 \odot (6 \oplus 7)) \odot (7 \oplus (6 \odot 5)) =$$

[AE, AR, BM, CE-2, MN, PH]

- (A) 40 (B) -40
(C) -33 (D) -26

- 1.93 If $\left\{ \begin{array}{l} \text{"}\oplus\text{" means "}-\text{"}, \\ \text{"}\otimes\text{" means "}\div\text{"}, \\ \text{"}\Delta\text{" means "}\div\text{"}, \\ \text{"}\nabla\text{" means "}\times\text{"}, \end{array} \right.$

then, the value of the expression

$$\Delta 2 \oplus 3 \Delta ((4 \otimes 2) \nabla 4) = \text{ [ME-1, XH]}$$

- (A) 7 (B) -0.5
(C) -1 (D) 6

- 1.94 If $\oplus \div \odot = 2$, $\oplus \div \Delta = 3$, $\odot + \Delta = 5$,
 $\Delta \times \otimes = 10$ then, the value of $(\otimes - \oplus)^2$ is

[ME-2, MT]

- (A) 4 (B) 1
(C) 0 (D) 16

- 1.95 A digital watch X beeps every 30 seconds while watch Y beeps 32 seconds. They beeped together at 10 AM. The immediate next time that they will beep together is _____.

[ME-2, MT]

- (A) 10 : 42 AM (B) 11 : 00 AM
(C) 10 : 00 PM (D) 10 : 08 AM

- 1.96 If $\left(x - \frac{1}{2}\right)^2 - \left(x - \frac{3}{2}\right)^2 = x + 2$, then the value of x is

[CS-2, XE, XL]

- (A) 6 (B) 4
(C) 8 (D) 2

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- 1.97 Both the numerator and the denominator of $\frac{3}{4}$ are increased by a positive integer

x and those of $\frac{15}{17}$ are decreased by the same integer. This operation results in the same value for both the fractions.

What is the value of x ?

[CE-2]

- (A) 3 (B) 4
(C) 1 (D) 2

- 1.98 Consider the following functions for non-zero positive integers, p and q .

$$f(p, q) = \underbrace{p \times p \times p \times \dots \times p}_{q \text{ terms}} = p^q;$$

$$f(p, 1) = p$$

$$g(p, q) = p^{p^{p^{p^{\dots}}}} \text{ (up to } q \text{ terms)}; g(p, 1) = p$$

Which one of the following options is correct based on the above?

[ME-2]

- (A) $f(2,2) = g(2,2)$
 (B) $fg(2,2), 2 < f(2, g(2,2))$
 (C) $g(2,1) \neq f(2,1)$
 (D) $f(3,2) > g(3,2)$

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- 1.99** A series of natural numbers $F_1, F_2, F_3, F_4, F_5, F_6, F_7, \dots$ obeys $F_{n+1} = F_n + F_{n-1}$ for all integers $n \geq 2$. If $F_6 = 37$, and $F_7 = 60$, then what is F_1 ?

[CSE]

- (A) 4 (B) 8
 (C) 5 (D) 9

- 1.100** There are two inequalities :

$$p^2 - 4q < 4$$

$$3p + 2q < 6$$

Where p and q are positive integers. The value of p + q is _____.

[ME]

- (A) 2 (B) 1
 (C) 3 (D) 4

- 1.101** The digit in the unit's place of product $3^{999} \times 7^{1000}$ is _____.

[EE]

- (A) 7 (B) 1
 (C) 3 (D) 9

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- 1.102** The greatest prime factor of $(3^{199} - 3^{196})$ is

- (A) 13 (B) 17
 (C) 3 (D) 11

[EC]

- 1.103** If the sum of the first 20 consecutive positive odd numbers is divided by 20^2 , the result is

- (A) 1 (B) 20

- (C) 2 (D) $\frac{1}{2}$

[IN, CE-2]

- 1.104** The ratio of the number of girls to boys in class VIII is the same as the ratio of the number of boys to girls in class IX. The total number of students (boys and girls) in classes VIII and IX is 450 and 360, respectively. If the number of girls in classes VIII and IX is the same, then the number of girls in each class is

- (A) 150 (B) 200
 (C) 250 (D) 175

[IN, CE-2]

- 1.105** In a locality, the houses are numbered in the following way:

The house-numbers on one side of a road are consecutive odd integers starting from 301, while the house-numbers on the other side of the road are consecutive even numbers starting from 302. The total number of houses is the same on both sides of the road.

If the difference of the sum of the house-numbers between the two sides of the road is 27, then the number of houses on each side of the road is

- (A) 27 (B) 52
 (C) 54 (D) 26

[CE-1, CH]

- 1.106** Which one of the given options is a possible value of x in the following sequence?

3, 7, 15, x, 63, 127, 255

- (A) 35 (B) 40
 (C) 45 (D) 31

[CE-1, CH]

- 1.107** On a given day, how many times will the second-hand and the minute-hand of a clock cross each other during the clock time 12:05:00 hours to 12:55:00 hours?

(A) 51 (B) 49
(C) 50 (D) 55

[CE-1, CH]

- 1.108** If the sum of the first 20 consecutive positive odd numbers is divided by 20^2 , the result is

(A) 1 (B) 20
(C) 2 (D) $\frac{1}{2}$

[CE-2, IN]

- 1.109** Find the odd one out in the set :
 $\{19, 37, 21, 17, 23, 29, 31, 11\}$

(A) 21 (B) 29
(C) 37 (D) 23

[ME]

- 1.110** In the following series, identify the number that needs to be changed to form the Fibonacci series.

1, 1, 2, 3, 6, 8, 13, 21, ...

(A) 8 (B) 21
(C) 6 (D) 13

[ME]

- 1.111** In the sequence 6, 9, 14, x , 30, 41, a possible value of x is

(A) 25 (B) 21
(C) 18 (D) 20

[CS-2]

- 1.112** How many 4-digit positive integers divisible by 3 can be formed using only the digits $\{1, 3, 4, 6, 7\}$, such that no digit appears more than once in a number ?

(A) 24 (B) 48
(C) 72 (D) 12

[PI, DA]

- 1.113** The sum of the following infinite series is

$$2 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{8} + \frac{1}{9} + \frac{1}{16} + \frac{1}{27} + \dots$$

(A) $\frac{11}{3}$ (B) $\frac{7}{2}$
(C) $\frac{13}{4}$ (D) $\frac{9}{2}$

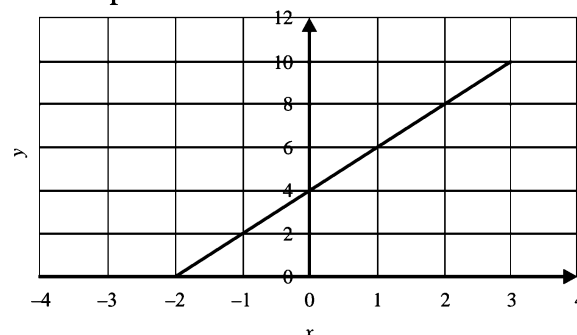
[PI, DA]

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- 1.114** The relationship between two variables x and y is given by $x + py + q = 0$ and is shown in the figure. Find the values of p and q .

[EE]

Note : The figure shown is representative.

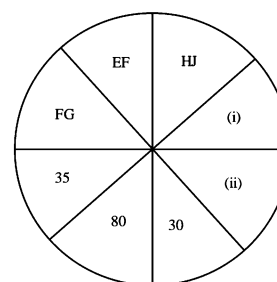


(A) $p = -\frac{1}{2}; q = 2$ (B) $p = 2; q = -2$

(C) $p = \frac{1}{2}; q = 4$ (D) $p = 2; q = 4$

- 1.115** In the given figure, EF and HJ are coded as 30 and 80, respectively. Which one among the given options is most appropriate for the entries marked (i) and (ii)?

[EE]



- (A) (i) EH; (ii) 40 (B) (i) JK; (ii) 36
(C) (i) EG; (ii) 42 (D) (i) PS; (ii) 14
- 1.116** Let p_1 and p_2 denote two arbitrary prime numbers. Which one of the following statements is correct for all values of p_1 and p_2 ? [IN, CS-2]
(A) $p_1 + p_2$ is not a prime number.
(B) $p_1 p_2$ is not a prime number.
(C) $p_1 + p_2 + 1$ is a prime number.
(D) $p_1 p_2 + 1$ is a prime number.
- 1.117** If IMAGE and FIELD are coded as FHBNJ and EMFJG respectively then, which one among the given options is the most appropriate code for BEACH? [IN, CS-2]
(A) CEADP (B) IDBFC
(C) JGIBC (D) IBCEC
- 1.118** The sum of the following infinite series is [CE-1, CH]
$$\frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \frac{1}{5!} + \dots$$

(A) π (B) $1 + e$
(C) $e - 1$ (D) e
- 1.119** If HIDE and CAGE are coded as 19-23-7-11 and 5-2-17-11 respectively, then what is the code for HIGH? [ME, PE]
(A) 5-17-1-2 (B) 17-19-13-17
(C) 13-3-1-2 (D) 19-23-17-19

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- 1.120** P and Q are two positive integers such that $P^2 = Q^2 + 13$. The product of the numbers P and Q is [EE, PI, CE-1]
(A) 13 (B) 26
(C) 39 (D) 42

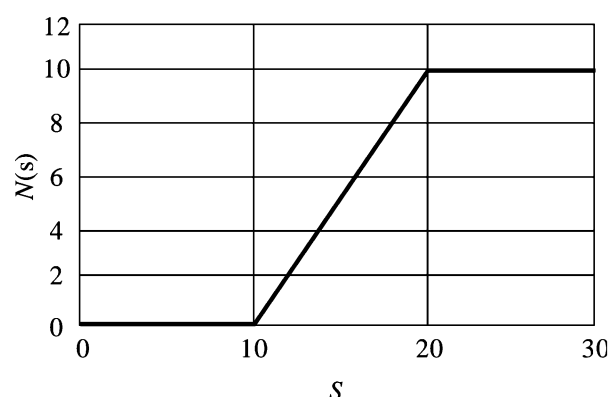
- 1.121** For positive real numbers S and K , the function $H_K(S)$ is defined as : [CS-1]

$H_K(S) = \max(S - K, 0)$. The max function is defined as :

$$\max(a, b) = \begin{cases} a, & \text{when } a > b \\ b, & \text{when } a \leq b \end{cases}$$

The graph below shows the plot of a function $N(s)$ versus S .

$N(S)$ can be expressed as _____.



- (A) $H_{10}(S) - H_{20}(S)$
(B) $H_{10}(S) - 2H_{20}(S)$
(C) $-H_{10}(S) + H_{20}(S)$
(D) $H_{15}(S) - H_{20}(S)$
- 1.122** The product of the digits of a three-digit number is 70. The sum of the digits of this three-digit number is [DA]
(A) 12 (B) 14
(C) 16 (D) 18
- 1.123** Consider two distinct positive real numbers m, n , with $m > n$. [DA]
Let $x = n^{\log_{10}(m)}$ and $y = m^{\log_{10}(n)}$. The relation between x and y is _____.
(A) $x > y$ (B) $x < y$
(C) $x = y$ (D) $x = \log_{10}(y)$

- 1.124 $P, Q, R, S, X,$ and Y are distinct single-digit whole numbers taking values from 0 to 9.

PQ is a two-digit number with Q being in the units place and P in the tens place.

Similarly, RS is a two-digit number.

It is known that PQ and RS are consecutive numbers and $(PQ)^2 + (RS)^2 = XYP$, with XYP being a three-digit number.

The value of Y is _____. [DA]

- (A) 4 (B) 5
(C) 6 (D) 7

Engineering Services Examination (ESE)

1. Ten years ago father was 12 times as old as his son and after 10 years father will be 2 times older than his son. The present ages of father and son respectively are :
- (A) 32 years and 14 years
(B) 34 years and 14 years
(C) 32 years and 12 years
(D) 34 years and 12 years

[ESE 2020]

2. A clock strikes once at 1 O'clock, twice at 2 O'clock, thrice at 3 O'clock and so on. The number of times it strikes in 24 hours will be
- (A) 116 (B) 136
(C) 156 (D) 196

[ESE 2020]

3. The sum of all the natural numbers between 1 and 101 which are divisible by 5 is :
- (A) 1000 (B) 1050
(C) 1500 (D) 2550

[ESE 2020]

4. What is the angle between the hour hand and minute hand of a clock at 3:30?

- (A) 105^0 (B) 180^0
(C) 75^0 (D) 90^0

[ESE 2021]

5. Sum of the series

$$2^2 + 4^2 + 6^2 + \dots + 20^2 \text{ is}$$

- (A) 1040 (B) 1540
(C) 2540 (D) 3080

[ESE 2021]

6. 21 mango trees, 42 apple trees and 56 orange trees have to be planted in rows such that each row contains the same number of trees of one variety only. Minimum number of rows in which the above trees may be planted is

- (A) 9 (B) 12
(C) 14 (D) 17

[ESE 2022]

7. A general wishes to draw up his 36562 soldiers in the form of a solid square. After arranging them, he found that some of them are left over. How many are left?

- (A) 81 (B) 75
(C) 61 (D) 52

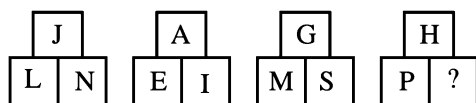
[ESE 2022]

8. Cryptic language is popular since ages mostly in the field of espionage and sending classified message. If 'I LOVE YOU' is coded as 7, then how would you code 'GO TO HELL' in the same language?

- (A) 1 (B) 4
(C) 3 (D) 5

[ESE 2023]

9. What letter should replace the question mark?

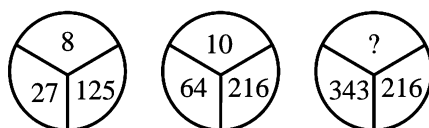


(A) Z
(C) X

(B) Y
(D) W

[ESE 2023]

10. In the first two circles, the number inside the circle is written according to a particular relation. What is the number inside the third circle which follows the same relation as that of the first two circles?



(A) 12
(C) 9

(B) 13
(D) 14

[ESE 2023]

11. Deepthi is playing a treasure hunt game. At the first stage, Deepthi needs to choose a five-digit code to unlock the vault which contains the treasure. She gets the following codes to choose from

15342 26540 35412

23105 15320 13402

35047 71024 28305

The following clues are given to her to help her to find the code.

- P. The code number is not an even number.
Q. The product of the first two digits is odd.
R. The sum of the first four digits is 12.
S. The code number is not a multiple of 5.

If Deepthi had the option of selecting only one clue, which of the four clues will give her the best chance of finding out the five-digit code?

(A) S
(C) Q

(B) R
(D) P

[ESE 2023]

12. A number series is given with one term missing. Choose the correct alternative from the options.

0.5, 0.55, 0.65, 0.8, ?

(A) 0.9
(C) 0.82

(B) 0.95
(D) 1

[ESE 2023]

13. Anuhya picks a number. She doubles the number, squares the result, divides the square by 3, subtracts 30 from the quotient, and gets 18. What are the possible numbers that Anuhya could have picked?

(A) 6 or -6
(C) 26 or -26

(B) 16 or -16
(D) 36 or -36

[ESE 2024]

14. Select a two-digit number between 50 and 100. Add 83 to your number. From this number form a new number by adding the digit in the hundreds place to the number formed by the other two digits (the digits in the tens place and the ones place). Now subtract this newly formed number from your original number, to arrive at the final result. What is the final result?

(A) 16
(C) 36

(B) 26
(D) 46

[ESE 2024]

15. A man has a certain number of small boxes to pack into parcels. If he packs 3, 4, 5 or 6 in a parcel, he is left one, if he packs 7 in a parcel, none is left over. What is the number of boxes, he may have to pack?

(A) 106

(B) 301

(C) 309

(D) 400

[ESE 2024]

16. The given number of letters skipped increase in the order of 2, 4, 6, 8,

Which of the following series observes the rule given ?

(A) ADIOVF

(B) BEJQZK

(C) DGKOTX

(D) GIKMOQ

[ESE 2025]

17. Ceramic raw materials are joined using a binder that does not require firing or sintering in a process called

(A) Coating

(B) Cementation

(C) Enamel

(D) Slip casting

[ESE 2025]

18. The long chain molecules are randomly oriented in

(A) Plastic

(B) Metal

(C) Diamond

(D) Coal

[ESE 2025]

19. A system or group of systems that enforces an access control policy between a trusted network and an untrusted network is called

(A) Perimeter access control

(B) Intrusion monitoring

(C) Interfacing the hardware components

(D) Managing the network privately

[ESE 2025]

20. What is the missing (?) value?

		7	4	1		
	8	1	7	2	3	
1	4	3	8	5	2	1
	2	1	4	1	4	
		7	?	3		

(A) 6

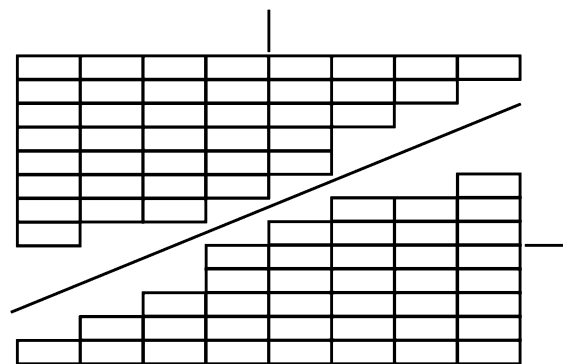
(B) 4

(C) 5

(D) 2

[ESE 2026]

21. What does this diagram demonstrate ?



$$1^2 + 2^2 + 3^2 + \dots + n^2$$

$$(A) \frac{n(n+1)(2n+1)}{6}$$

$$(B) 1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$$

$$(C) \frac{2n(n+1)(2n+1)}{3}$$

(D) None of the above

[ESE 2026]

Answers	Number System & Series
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1.1	C	1.2	B	1.3	B	1.4	A	1.5	C
1.6	B	1.7	C	1.8	C	1.9	D	1.10	A
1.11	A	1.12	D	1.13	C	1.14	A	1.15	C
1.16	D	1.17	C	1.18	B	1.19	D	1.20	45
1.21	A	1.22	725	1.23	D	1.24	C	1.25	163
1.26	16	1.27	D	1.28	B	1.29	495	1.30	C
1.31	B	1.32	96	1.33	B	1.34	C	1.35	C
1.36	C	1.37	D	1.38	C	1.39	B	1.40	A
1.41	C	1.42	3	1.43	B	1.44	A	1.45	C
1.46	4536	1.47	C	1.48	C	1.49	D	1.50	C
1.51	B	1.52	C	1.53	7	1.54	A	1.55	C
1.56	D	1.57	C	1.58	A	1.59	B	1.60	D
1.61	D	1.62	B	1.63	B	1.64	D	1.65	C
1.66	D	1.67	B	1.68	B	1.69	C	1.70	A
1.71	B	1.72	B	1.73	C	1.74	C	1.75	B
1.76	B	1.77	D	1.78	C	1.79	B	1.80	C
1.81	B	1.82	C	1.83	C	1.84	D	1.85	D
1.86	C	1.87	D	1.88	D	1.89	A	1.90	B
1.91	A	1.92	B	1.93	A	1.94	B	1.95	D
1.96	B	1.97	A	1.98	A	1.99	A	1.100	A
1.101	A	1.102	A	1.103	A	1.104	B	1.105	A
1.106	D	1.107	C	1.108	A	1.109	A	1.110	C
1.111	B	1.112	B	1.113	B	1.114	A	1.115	C
1.116	B	1.117	B	1.118	C	1.119	D	1.120	D
1.121	A	1.122	B	1.123	C	1.124	C		
Engineering Services Examination (ESE)									
1.	D	2.	C	3.	B	4.	C	5.	B
6.	D	7.	A	8.	B	9.	C	10.	B
11.	B	12.	D	13.	A	14.	A	15.	B
16.	B	17.	B	18.	A	19.	A	20.	D
21.	B								

Explanations

Number System & Series

1.1 (C)

Given : $137 + 276 = 435$

7 and 6 added is becoming 5 means the given two numbers are added on base 8.

$$\begin{array}{r} (137)_8 \\ + (276)_8 \\ \hline (435)_8 \end{array}$$

Add another two given set of numbers also on base 8.

$$\begin{array}{r} (731)_8 \\ + (672)_8 \\ \hline (1623)_8 \end{array}$$

Thus, the overall problem was based on identifying base which was 8 and adding numbers on base 8.

Hence, the correct option is (C).

1.2 (B)

Given : Digits are 2, 2, 3, 3, 3, 4, 4, 4, 4

As the number is greater than 3000. So thousand's place can be either 3 or 4

Let us consider the following two cases.

Case 1 : When thousand's place is 3

$$\underline{3} \underline{a} \underline{b} \underline{c}$$

If there is no restriction on number of two's, three's and four's. Then each of a, b, c can be filled with 2 or 3 or 4 each in 3 ways.

So, $3 \times 3 \times 3 = 27$ numbers are there. Out of which 3222, 3333 are invalid as 2 can be used twice and 3 thrice only.

So number of such valid numbers beginning with 3 are $27 - 2 = 25$

Case 2 : When thousand's place is 4

$$\underline{4} \underline{a} \underline{b} \underline{c}$$

Without restriction on number of 2's, 3's and 4's a, b, c can be filled in 27 ways (as explained in case 1)

Out of these 27 numbers, 4222 is only invalid as two have to be used twice only. So valid numbers are $27 - 1 = 26$

Total numbers from case 1 and case 2 is

$$25 + 26 = 51$$

Hence, the correct option is (B).

1.3 (B)

We can observe that there is sum of two series.

$$\left(\frac{(1)}{2} + \frac{(-1)}{2^2} + \frac{(1)}{2^3} + \frac{(-1)}{2^4} + \frac{(1)}{2^5} + \frac{(-1)}{2^6} + \frac{(1)}{2^7} + \dots \right) + \left(\frac{1}{3^1} + \frac{1}{3^2} + \frac{1}{3^3} + \frac{1}{3^4} + \frac{1}{3^5} + \dots \right)$$

Both parts are in G.P. series

First series with $a = \frac{1}{2}$ and $r = \frac{(-1)}{2}$

$$\text{Infinite sum} = \frac{a}{1-r} = \frac{\frac{1}{2}}{1 - \frac{(-1)}{2}} = \frac{1}{3}$$

Second series with $a = \frac{1}{3}$ and $r = \frac{1}{3}$

$$\text{Infinite sum} = \frac{a}{1-r} = \frac{\frac{1}{3}}{1 - \frac{1}{3}} = \frac{1}{2}$$

$$\text{Final sum} = \frac{1}{3} + \frac{1}{2} = \frac{5}{6}$$

Hence, the correct option is (B).

1.4 (A)

Given : A, B, B, C, C, C, D, D, D, D, ...etc.

Here, each alphabets is repeated as many times as its position in the alphabetical order.

Alphabet	Position in alphabetical order	Position in the given sequence
A	1	1 st
B	2	2 nd and 3 rd

C	3	4 th , 5 th and 6 th
D	4	7 th , 8 th , 9 th and 10 th
...	...	...
Some alphabet	n	$\left(\frac{n(n+1)}{2} - n + 1\right),$ $\left(\frac{n(n+1)}{2} - n + 2\right),$ $\dots, 240^{\text{th}}, \dots,$ $\left(\frac{n(n+1)}{2} - n + n\right)$

Here, $\frac{n(n+1)}{2}$ is the last position in the given sequence for an alphabet whose position is n in the alphabetical order. So, if we have to find an alphabet whose position is i^{th} in the given sequence and whose position is n in the alphabetical order then we have to find smallest integer value of n such that $\frac{n(n+1)}{2} \geq i$.

For example, if $i=5$, it means we have to find alphabet whose position is 5th in the given sequence, then we have to find minimum value of n such that $\frac{n(n+1)}{2} \geq 5$. So, minimum value of $n=3$ means it will be alphabet C.

Similarly, if $i=8$ means we have to find alphabet whose position is 8th in the given sequence, then we have to find minimum value of n such that $\frac{n(n+1)}{2} \geq 8$, So, minimum value of $n=4$ means it will be alphabet D.

Now, in this question, we have to find smallest integer value of n such that

$$\frac{n(n+1)}{2} \geq 240$$

$$\left\{ \text{Sum of first } n \text{ natural numbers} = \frac{n(n+1)}{2} \right\}$$

$$n(n+1) \geq 480$$

Options given are V, U, T, W. So, value of n can be 22, 21, 20 or 23.

$$\text{For } V, n=22 \Rightarrow n(n+1) = 506 \geq 480$$

$$\text{For } U, n=21 \Rightarrow n(n+1) = 462 \leq 480$$

$$\text{For } T, n=20 \Rightarrow n(n+1) = 420 \leq 480$$

$$\text{For } W, n=23 \Rightarrow n(n+1) = 552 \geq 480$$

Smallest value of n for $\frac{n(n+1)}{2} \geq 240$ is 22.

For $n=22$, alphabet is V.

Hence, the correct option is (A).

1.5 (C)

Given :

$$S = \{1, 2, 3, \dots, 4999, 5000\}$$

Let 'A' be the set of integers divided by '3' is

$$A = \{3, 6, 9, 12, 15, \dots, 4998\}$$

Let 'B' be the set of integers divided by '4' is

$$B = \{4, 8, 12, 16, \dots, 5000\}$$

Let 'C' be the set of integers divisibly by both '3' and '4' is

$$C = \{12, 24, 36, \dots, 4992\}$$

$$|A| = 3 + (n-1) \times 3 = 4998 \Rightarrow n = \frac{4998}{3} = 1666$$

$$|B| = 4 + (n-1) \times 4 = 5000 \Rightarrow n = \frac{5000}{4} = 1250$$

$$|C| = 12 + (n-1) \times 12 = 4992 \Rightarrow n = \frac{4992}{12} = 416$$

Divisible by '3' or '4' is $\{3, 4, 6, 8 \dots 5000\}$:

$$\begin{aligned}
 |D| &= |A| + |B| - |C| \\
 &= 1666 + 1250 - 416 \\
 &= 2500
 \end{aligned}$$

Number of integers that is divisible by neither '3' nor '4' is :

$$\begin{aligned}
 &= |S| - |D| \quad \{ |S| = 5000 \} \\
 &= 5000 - 2500 = 2500
 \end{aligned}$$

Hence, the correct option is (C).

1.6 (B)

Given : $p - q = 990$

Hence, $p = 1100$, $q = 110$

In base 10 subtraction, we are getting result 990.

Since, p is in base 2, it can have digits 0 or 1 only. And since q is in base 3, it can have digits 0, 1, 2 only.

We can get result digit '0' by either '0 - 0' or '1 - 1'

We can get result digit '9' by either '10 - 1' or '11 - 2'

So, possible value of p and q can be (their decimal values must be same too)

$$(1100)_2 \text{ and } (110)_3 = (12)_{10}$$

$$(1101)_2 \text{ and } (111)_3 = (13)_{10}$$

So, only option (B) is matching the answer.

Hence, the correct option is (B).

1.7 (C)

Given : n^{th} series is,

$$4 + 44 + 444 + \dots$$

Method 1

First term of series = 4

So, sum upto 1st term = 4

Put, $n = 1$ (first term) only option (C) satisfies.

$$S = \frac{4}{81} [10^{n+1} - 9n - 10]$$

At $n = 1$,

$$S = \frac{4}{81} [10^{1+1} - (9 \times 1) - 10]$$

$$S = \frac{4}{81} \times 81 = 4$$

Hence, the correct option is (C).

Method 2

$$S = \frac{4}{9} [9 + 99 + 999 + \dots]$$

$$S = \frac{4}{9} [(10 - 1) + (10^2 - 1) + (10^3 - 1) + \dots]$$

$$S = \frac{4}{9} [(10 + 10^2 + 10^3 + \dots + 10^n) - (1 + 1 + 1 + \dots)]$$

$$S = \frac{4}{9} [10(1 + 10 + 10^2 + \dots + 10^{n-1}) - (1 + 1 + 1 + \dots)]$$

$$S = \frac{4}{9} \left[10 \left(\frac{10^n - 1}{10 - 1} \right) - n \right] = \frac{4}{9} \left[\frac{10^{n+1} - 10 - 9n}{9} \right]$$

$$S = \frac{4}{81} [10^{n+1} - 9n - 10]$$

Hence, the correct option is (C).

1.8 (C)

Given : Three friends R , S and T share toffees as below,

Firstly, R took $1/3^{\text{rd}}$ and returned 4.

Then, S took $1/4^{\text{th}}$ and returned 3.

Then, T took $1/2^{\text{nd}}$ and returned 2.

Now, the bowl has 17 toffees left.

Method 1

The question can be done orally as R took $1/3^{\text{rd}}$ of toffees initially. So, the total number of toffees have to be a multiple of 3.

Only the number 48 is multiple of 3, from the options.

Hence, the correct option is (C).

Method 2

Let x be the total number of toffees in bowl initially.

And r , s and t are toffees taken by R , S and T respectively.

According to question,

$$r = \frac{x}{3} - 4$$

Number of toffees left,

$$y = x - \left(\frac{x}{3} - 4 \right) = \frac{2x}{3} + 4 \quad \dots(i)$$

S took $1/4^{\text{th}}$ of y and returned 3

$$\text{So, } s = \frac{y}{4} - 3$$

Number of toffees left,

$$z = y - \left(\frac{y}{4} - 3 \right) = \frac{3y}{4} + 3$$

$$z = \frac{3}{4}y + 3$$

From equation (i),

$$z = \frac{3}{4} \left(\frac{2x}{3} + 4 \right) + 3$$

$$z = \frac{x}{2} + 6 \quad \dots(ii)$$

T took $1/2$ of z and returned 2 back,

So, $t = \frac{z}{2} - 2$

Finally, number of toffees left

$$17 = z - \left(\frac{z}{2} - 2 \right) = \frac{z}{2} + 2$$

$$17 = \frac{1}{2} \left(\frac{x}{2} + 6 \right) + 2 \quad [\text{from equation (ii)}]$$

$$17 = \frac{x}{4} + 5$$

$$x = 48$$

Hence, the correct option is (C).

1.9 (D)

Given : $(1.001)^{1259} = 3.52$ and $(1.001)^{2062} = 7.85$

Method 1

Let $S = (1.001)^{3321}$

Since, $a^n \times a^m = a^{n+m}$

$$S = (1.001)^{1259+2062}$$

$$S = (1.001)^{1259} \times (1.001)^{2062}$$

$$S = 3.52 \times 7.85 = 27.64$$

Hence, the correct option is (D).

Method 2

Taking the product of greatest integer values i.e. $3 \times 7 = 21$, it is concluded that the correct answer is obviously greater than 21.

Hence, the correct option is (D).

1.10 (A)

Let number of Rs. 20 notes be x

Number of Rs. 10 notes be y .

$$20x + 10y = 230$$

$$2x + y = 23 \quad \dots(i)$$

and $x + y = 14 \quad \dots(ii)$

From equation (i) and (ii),

$$x = 9 \text{ and } y = 5$$

Thus, the numbers of 10 rupee notes are 5.

Hence, the correct option is (A).

1.11 (A)

Let, the eight bags are

$$A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8$$

Let three are placed on one side of balance and three on other side; say A_1, A_2, A_3 on one and A_4, A_5, A_6 on another. If they are equal obviously A_7 or A_8 is heavier means one additional trial is required. Hence, total two trials are required.

If they are unequal, let A_1, A_2, A_3 is heavier than A_4, A_5, A_6 obviously heavier one is among A_1, A_2 and A_3 .

Now put A_1 on one of the side of balance and A_2 on another side.

If $A_1 = A_2$ obviously A_3 is heavier.

If $A_1 > A_2$ or $A_1 < A_2$ obviously A_1 or A_2 is heavier, then atleast two trials needed.

Hence, the correct option is (A).

1.12 (D)

Given :

As we know that, $\log m + \log n = \log m.n$

$$\log x + \log(x-7) = \log(x+11) + \log 2$$

So, $\log x(x-7) = \log 2(x+11)$

$$x(x-7) = 2(x+11)$$

$$x^2 - 9x - 22 = 0$$

$$x^2 - 11x + 2x - 22 = 0$$

$$x(x-11) + 2(x-11) = 0$$

$$(x-11)(x+2) = 0$$

$$x = 11$$

$$x \neq -2,$$

log is undefined for negative number.

Hence, the correct option is (D).

1.13 (C)

Given : Number of terms = 5, Average = 12

The sum of natural numbers = 60

Thus, the largest possible values among the numbers must be less than 60.

By options, answer must be 50.

Hence, the correct option is (C).

Key Point

Sum of natural numbers

$$= \text{Number of terms} \times \text{average}$$

1.14 (A)

Theorem : If p is a prime number which has remainder 1 when divided by 4, then p can be written as a sum of two squares.

Example:

- $5 = 1 + 4$
- $13 = 9 + 4$
- $17 = 16 + 1$
- $29 = 25 + 4$
- $37 = 36 + 1$
- $41 = 25 + 16$
- and so on.

Hence, option (A) is correct.

From option (B) : Sum of cubes of two natural numbers.

Counter example : 5 cannot be represented as cubes of two natural numbers.

$$(1^3 = 1, 2^3 = 8 \Rightarrow 1 + 8 = 9 \neq 5)$$

So, option (B) is not correct.

From option (C) : Sum of square roots of two natural numbers.

Let, $p = 4n + 1$, $n \geq 0$ and p is a prime number.

The smallest value of p is 5.

So, any p can be written as $p = p_1 + p_2$ where p_1 and p_2 are natural numbers. Now existence of p_1^2 and p_2^2 makes the option (C) correct.

From option (D) : Sum of cube roots instead of p_1^2 and p_2^2 in above explanation we just need to change to p_1^3 and p_2^3 .

So, the correct options are (A), (C) and (D).

It is better to pick option (A) here, because Options (C) and (D) seem to be given by mistake.

This question can also be asked in MSQ type.

Hence, the correct option is (A).

1.15 (C)

Given : The mean temperatures for a certain week are :

Monday to Wednesday = 41°C

Tuesday to Thursday = 43°C

Let the temperatures on Monday, Tuesday, Wednesday and Thursday is M , T , W and Th respectively.

$$\text{So, } \frac{M + T + W}{3} = 41$$

$$M + T + W = 123 \quad \dots(i)$$

$$\text{And also, } \frac{T + W + Th}{3} = 43$$

$$T + W + Th = 129 \quad \dots(ii)$$

Subtracting equation (i) from equation (ii),

$$Th - M = 6 \quad \dots(iii)$$

According to question, temperature on Thursday was 15% higher than that of Monday.

$$Th = 1.15 \times M \quad \dots(iv)$$

From equations (iii) and (iv),

$$1.15M - M = 6$$

$$0.15M = 6$$

$$M = \frac{6}{0.15}$$

$$Th = 1.15 \times \frac{6}{0.15} = 46^{\circ}\text{C}$$

Hence, the correct option is (C).

1.16 (D)

Given : Series is $10 + 84 + 734 + \dots$

Method 1

Check from the options by substituting

$$n = 1, 2, \dots$$

For $n = 1$:

From option (A),

$$\frac{9(9^1 + 1)}{10} + 1 = 10$$

From option (B),

$$\frac{9(9^1 - 1)}{8} + 1 = 10$$

From option (C),

$$\frac{9(9^1 - 1)}{8} + 1 = 10$$

From option (D),

$$\frac{9(9^1 - 1)}{8} + 1^2 = 10$$

For $n = 1$, all options are right.

For $n = 2$, sum must be $10 + 84 = 94$.

Only option (D) is correct for this and we can go through that.

Hence, the correct option is (D).

Method 2

Sum of n terms of series,

$$S_n = 10 + 84 + 734 + \dots$$

$$S_n = (9 + 1) + (81 + 3) + (729 + 5) + \dots$$

$$S_n = (9 + 81 + 729 + \dots) + (1 + 3 + 5 + \dots)$$

$$S_n = (9 + 9^2 + 9^3 + \dots n \text{ terms})$$

$$+ (1 + 3 + 5 + \dots n \text{ terms})$$

$$S_n = 9 \left[\frac{9^n - 1}{9 - 1} \right] + \frac{n}{2} [2 \times 1 + (n - 1)2]$$

$$S_n = \frac{9}{8} (9^n - 1) + n^2$$

Hence, the correct option is (D).

1.17 (C)

Given : 44, 42, 40 ...

The given series is decreasing by 2. For the sum to be maximum, the series should not include negative numbers. So, the series should be 44, 42, 40, 38 ... 2, 0

$$\text{Sum} = 0 + 2 + 4 \dots 44$$

$$\text{Sum} = 2(1 + 2 + 3 \dots 22)$$

Given series is an A.P. series.

Therefore, sum of the series is given by,

$$\text{Sum} = \frac{n}{2} (a + l)$$

where, n = number of terms

a = first term, l = last term

$$\text{Sum} = 2 \times \left[\frac{22}{2} (1 + 22) \right] = 506$$

Hence, the correct option is (C).

1.18 (B)

$$\text{Let } S = \frac{1}{\sqrt{1} + \sqrt{2}} + \frac{1}{\sqrt{2} + \sqrt{3}} + \frac{1}{\sqrt{3} + \sqrt{4}} + \dots + \frac{1}{\sqrt{80} + \sqrt{81}}$$

$$S = \left(\frac{\sqrt{2} - \sqrt{1}}{(\sqrt{2})^2 - (\sqrt{1})^2} \right) + \left(\frac{\sqrt{3} - \sqrt{2}}{(\sqrt{3})^2 - (\sqrt{2})^2} \right) + \dots + \left(\frac{\sqrt{81} - \sqrt{80}}{(\sqrt{81})^2 - (\sqrt{80})^2} \right)$$

$$S = (\sqrt{2} - \sqrt{1}) + (\sqrt{3} - \sqrt{2}) + \dots + (\sqrt{81} - \sqrt{80})$$

$$S = \sqrt{81} - 1 = 9 - 1 = 8$$

Hence, the correct option is (B).

1.19 (D)

Let the unknown, number be y .

According to question,

$$y = 75 + x \quad \dots (i)$$

$$y = 117 - x \quad \dots (ii)$$

From equation (i) and (ii),

$$y = 96$$

Hence, the correct option is (D).

1.20 45

Given : Series is

$$2 \quad 3 \quad 6 \quad 15 \quad x \quad 157.5 \quad 630$$

Let the missing number is 'x'

$$\text{Here : } \frac{3}{2} = 1.5, \quad \frac{6}{3} = 2, \quad \frac{15}{6} = 2.5, \quad \frac{630}{157.5} = 4$$

$$\text{Series : } 1.5, \quad 2, \quad 2.5, \quad \frac{x}{15}, \quad \frac{157.5}{x}, \quad 4$$

The ratio of consecutive numbers is in AP where,

Common difference $d = 0.5$

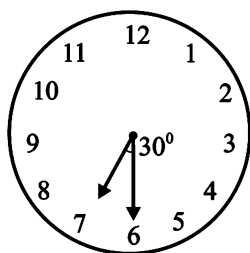
First term $a = 1.5$

Then according to the given series,

$$\frac{x}{15} = a + 3d$$

$$\frac{x}{15} = 3 \Rightarrow x = 45$$

Hence, the missing number in the series is **45**.

1.21 (A)**Method 1**

For any clock the angle between any two consecutive numbers (out of 1 to 12) = 30° .

As hour needle moves in one hour or 60 mins from 6 to 7 i.e. 30° .

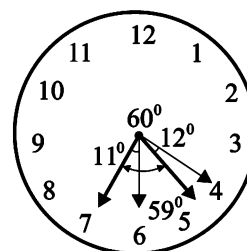
At 6 : 22 am, The hour needle moves by angle

$$\frac{22}{60} \times 30^\circ = 11^\circ$$

The minute needle moves from 4 to 5 i.e. in 5 minutes by 30° .

Thus, within 2 min (from 6 : 20 to 6 : 22), the angle by which it moves

$$= \frac{2}{5} \times 30^\circ = 12^\circ$$



Thus, the angle between two needles at 6:22 am is 59° .

Hence, the correct option is (A).

Method 2

We can also measure the angle by this formula.

$$\text{Angle} = 30H - \frac{11}{2}M$$

From option (A) :

Here, Hour (H) = 6 and minute (M) = 22

$$\text{Hence, Angle} = 30 \times 6 - \frac{11}{2} \times 22 = 59^\circ$$

From option (B) :

$$\text{Angle} = 30 \times 6 - \frac{11}{2} \times 27 = 31.5^\circ$$

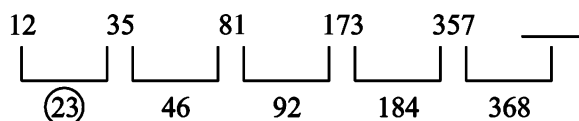
From option (C) :

$$\text{Angle} = 30 \times 6 - \frac{11}{2} \times 38 = 29^\circ$$

From option (D) :

$$\text{Angle} = 30 \times 6 - \frac{11}{2} \times 45 = 67.5^\circ$$

Hence, the correct option is (A).

1.22 725**Given :** Series is 12 35 81 173 357 _

Difference

In the given series consecutive difference doubles with each term.

So,

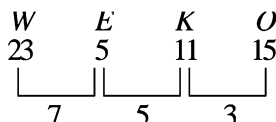
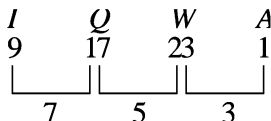
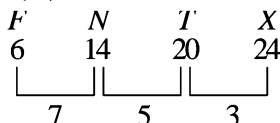
$$\begin{array}{r} 357 \\ + 368 \\ \hline 725 \end{array}$$

Hence, the next number in the series is **725**.**1.23** (D)

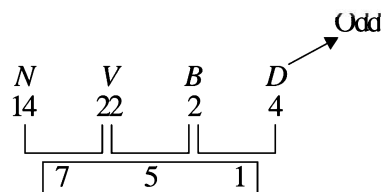
The alphabets can be numbered as given below,

A	B	C	D	E	F	G	H	I
1	2	3	4	5	6	7	8	9
J	K	L	M	N	O	P	Q	R
10	11	12	13	14	15	16	17	18
S	T	U	V	W	X	Y	Z	
19	20	21	22	23	24	25	26	

Notice the pattern of given options using the above table.

Option (A) :**Option (B) :****Option (C) :**

The numbers 7, 5 and 3 represent the number of alphabets in between.

Option (D) :

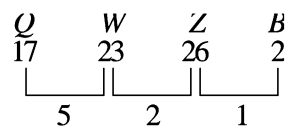
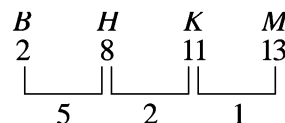
Hence, the correct option is (D).

1.24 (C)

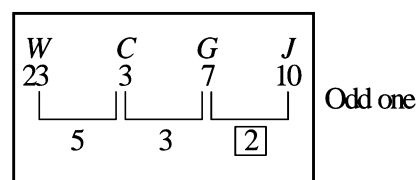
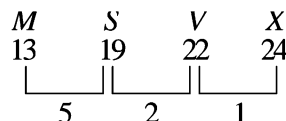
The alphabets can be numbered as given below,

A	B	C	D	E	F	G	H	I
1	2	3	4	5	6	7	8	9
J	K	L	M	N	O	P	Q	R
10	11	12	13	14	15	16	17	18
S	T	U	V	W	X	Y	Z	
19	20	21	22	23	24	25	26	

Notice the pattern of given options using the above table.

Option (A) :**Option (B) :**

The numbers 5, 2 and 1 represent the number of alphabets in between.

Option (C) :**Option (D) :**

Hence, the correct option is (C).

1.25 163

Method 1

(i) For odd numbers :

Let 1st term = a_0 Common difference, $d = 2$ $n = 8$

Sum of AP series,

$$S_n = na_0 + \frac{n(n-1)}{2}d = 656$$

$$S_n = 8a_0 + \frac{8 \times 7}{2} \times 2 = 656$$

$$a_0 = 75$$

(ii) For even numbers :

Let 1st term = a_e Common difference, $d = 2$ $n = 4$

$$\text{Average of } n \text{ consecutive numbers} = \frac{S_n}{n} = 87$$

$$\frac{1}{n} \times S_n = \frac{1}{n} \left[na_e + \frac{n(n-1)}{2}d \right]$$

$$87 = a_e + \frac{(n-1)}{2} \times d$$

$$87 = a_e + \frac{(4-1)}{2} \times 2$$

$$a_e = 84$$

Hence, the sequence is,

84, 86, 88, 90

The second largest number is 88.

Sum of smallest odd number and second largest even number is,

$$= 75 + 88 = 163$$

Hence, the sum of the following numbers is **163**.**Method 2**

Let us consider eight consecutive odd numbers, they are

$$a-6, a-4, a-2, a, a+2, a+4, a+6, a+8$$

Sum of eight consecutive odd numbers = 656

$$a-6 + a-4 + a-2 + a + a+2 + a+4$$

$$+ a+6 + a+8 = 656$$

$$8a + 8 = 656$$

$$a + 1 = 82$$

$$a = 81$$

Smallest odd number

$$a - 6 = 81 - 6 = 75 \quad \dots(i)$$

Again consider four consecutive even number,

$$b-2, b, b+2, b+4$$

Average of these numbers :

$$\frac{b-2 + b + b+2 + b+4}{4} = 87$$

$$4b + 4 = 87 \times 4$$

$$b + 1 = 87$$

$$b = 86$$

And second largest even number

$$b + 2 = 86 + 2 = 88 \quad \dots(ii)$$

Adding equations (i) and (ii),

$$75 + 88 = 163$$

Hence, the sum of the following numbers is **163**.

1.26 16

Given : Series is 81, 54, 36, 24, ...Let 5th term is x .Then 81, 54, 36, 24, x

Therefore,

$$\frac{54}{81} = \frac{2}{3}, \frac{36}{54} = \frac{2}{3}, \frac{24}{36} = \frac{2}{3}$$

$$\text{Hence, } \frac{x}{24} = \frac{2}{3}$$

$$x = 16$$

Hence, the next term in the series is **16**.

1.27 (D)

In option (A), P and M both are less than R but there is no clear relation between P and M .In option (B), P and M both are greater than R but again there is no clear relation between P and M .

In option (C), $P = F$ and $F > M$, so $P > M$ therefore it is incorrect.

In option (D), $P = A$ and $A < M$ therefore $P < M$ is definitely true.

Hence, the correct option is (D).

1.28 (B)

Given : Sequence is,

7G, 11K, 13M, ____

A	B	C	D	E	F	G	H	I
1	2	3	4	5	6	7	8	9
J	K	L	M	N	O	P	Q	R
10	11	12	13	14	15	16	17	18
S	T	U	V	W	X	Y	Z	
19	20	21	22	23	24	25	26	

Here, 7, 11, 13 are consecutive prime number.

Thus next prime number will be 17.

and G is 7th alphabet, K is 11th alphabet and M is 13th alphabet.

7th, 11th and 13th are again consecutive prime number.

So, the next alphabet will be 17th alphabet which is Q.

Thus, the next term will be 17Q.

Hence, the correct option is (B).

1.29 495

Given : In a sequence of 12 consecutive odd numbers, sum of the first 5 numbers is 425.

Let the sequence is :

$$a, a+2, a+4, a+6, \dots, a+22$$

Method 1

Sum of first five odd numbers is,

$$425 = a + (a+2) + (a+4) + (a+6) + (a+8)$$

$$425 = 5a + 20$$

$$a = 81$$

Sum of last five odd numbers is given by,

$$= (a+14) + (a+16) + (a+18) + (a+20) + (a+22)$$

$$= 5a + 90$$

$$= (5 \times 81) + 90 = 495$$

Hence, the sum of the last 5 numbers in the sequence is **495**.

Method 2

It is an AP series where,

First term = a (let)

Common difference, $d = 2$

Thus Sum of first n terms is given by,

$$S_n = na + \frac{n(n-1)d}{2}$$

Sum of 5 consecutive numbers,

$$S_5 = 5 \times a + \frac{5 \times 4}{2} \times 2$$

According to question,

$$425 = 5a + 20$$

$$a = 81$$

Sum of 12 consecutive numbers is,

$$S_{12} = 12a + \frac{12 \times 11}{2} \times 2 = 1104$$

Sum of first 7 consecutive numbers is,

$$S_7 = 7a + \frac{7 \times 6}{2} \times 2 = 609$$

So, the sum of last 5 terms is given by,

$$= S_{12} - S_7 = 1104 - 609 = 495$$

Hence, the sum of the last 5 numbers in the sequence is **495**.

1.30 (C)

Given : Sequence is

13M, 17Q, 19S, ____

A	B	C	D	E	F	G	H	I
1	2	3	4	5	6	7	8	9
J	K	L	M	N	O	P	Q	R
10	11	12	13	14	15	16	17	18
S	T	U	V	W	X	Y	Z	
19	20	21	22	23	24	25	26	

Checking from the options, only option (C) has the correct combination of number and alphabet. Hence, the correct option is (C).

1.31 (B)

Overall there will be $5! = 120$ numbers

Digit 1 will appear at unit, tenth, hundredth, thousandth and ten thousandth place $4!$ times each. So sum received due to all 1's will be

$$4! \times (1 + 10 + 100 + 1000 + 10000) \\ = 4! \times 11111$$

Similarly, sum received due to all 3's

$$= 4! (3 + 30 + 300 + 3000 + 30,000) \\ = 4! \times 33333$$

Similarly, sum received due to all 5's

$$= 4! (5 + 50 + 500 + 5000 + 50,000) \\ = 4! \times 55555$$

Similarly, sum received due to all 7's

$$= 4! (7 + 70 + 700 + 7000 + 70,000) \\ = 4! \times 77777$$

Similarly, sum received due to all 9's

$$= 4! (9 + 90 + 900 + 9000 + 90,000) \\ = 4! \times 99999$$

So, overall sum received due to all digits

$$= 4! \times 11111 \times (1 + 3 + 5 + 7 + 9) \\ = 4! \times 11111 \times 25 = 6666600$$

Hence, the correct option is (B).

1.32 96

Given : $\left(z + \frac{1}{z}\right)^2 = 98$

$$z^2 + \frac{1}{z^2} + \left(2 \times z \times \frac{1}{z}\right) = 98$$

$$z^2 + \frac{1}{z^2} = 96$$

Hence, the correct answer is **96**.

1.33 (B)

The all multiple of 10 from 2 to 198 are
10, 20, 30...190

It is an A.P. series :

First term (a) = 10

Common difference (d) = 10

Number of terms (n) = 19

The sum of A.P. series for n terms is,

$$S_n = \frac{n}{2} [2a + (n-1)d]$$

$$S_n = \frac{19}{2} [20 + 18 \times 10] = 1900$$

$$\text{Average} = \frac{\text{Sum of terms}}{\text{Number of terms}} = \frac{1900}{19} = 100$$

Hence, the correct option is (B).

1.34 (C)

Let $y = \sqrt{12 + \sqrt{12 + \sqrt{12 + \dots \infty}}}$

$$y = \sqrt{12 + y}$$

$$y^2 = 12 + y$$

$$y^2 - y - 12 = 0$$

$$y = \frac{1 \pm \sqrt{1 + 48}}{2} = \frac{1 \pm 7}{2} = 4, -3$$

Since, square root of a positive number is always a positive number. Therefore, y should also be a positive number.

Thus, the value of given sum must be,

$$y = 4 \quad [y \neq -ve]$$

Hence, the correct option is (C).

1.35 (C)

Given :

The series 2, 5, 10, 17, 26, 37, 50, 64.

The difference in consecutive numbers is

$$5 - 2 = 3,$$

$$10 - 5 = 5,$$

$$17 - 10 = 7,$$

$$26 - 17 = 9,$$

$$37 - 26 = 11,$$

$$50 - 37 = 13,$$

$$64 - 50 = 14$$

The difference is 3, 5, 7, 9, 11, 13 and thus next difference should be 15 (not 14).

So, the last number should be $50 + 15 = 65$

Which means that 64 doesn't belong to the given series.

Hence, the correct option is (C).

1.36 (C)

Method 1

Given : $(7526)_8 - (Y)_8 = (4364)_8$

$$(Y)_8 = (7526)_8 - (4364)_8$$

$$(7526)_8 \xrightarrow{\text{convert to decimal}}$$

$$[7 \times 8^3 + 5 \times 8^2 + 2 \times 8^1 + 6 \times 8^0] = (3926)_{10}$$

$$(4364)_8 \xrightarrow{\text{convert to decimal}}$$

$$[4 \times 8^3 + 3 \times 8^2 + 6 \times 8^1 + 4 \times 8^0] = (2292)_{10}$$

Now,

$$\begin{array}{r} (3926)_{10} \\ - (2292)_{10} \\ \hline (1634)_{10} \end{array}$$

$$(1634)_{10} \xrightarrow{\text{convert to octal}}$$

8	1634	
8	204	2
8	25	4
	3	1

$$(y)_8 = (3142)_8$$

Hence, the correct option is (C).

Method 2

$$(Y)_8 = (7526)_8 - (4364)_8$$

$$(Y)_8 = \frac{7526 - 4364}{3142} = (3142)_8$$

Hence, the correct option is (C).

1.37 (D)

Given : ALRVX, EPVZB, ITZDF, OYEIK

Method 1

Option (A) : It consists of only one vowel.

Option (B) : It consists of only one vowel.

Option (C) : It consists of only one vowel.

Option (D) : It consists of three vowels.

Hence, the correct option is (D).

Method 2

Option (A) : A – L – R – V – X

A – L : 10 alphabets between A and L.

L – R : 5 alphabets between L and R.

R – V : 3 alphabets between R and V.

V – X : 1 alphabet between V and X.

Similar for option (B) and (C).

Option (D) : OYEIK

O – Y : 9 alphabets between O and Y.

Y – E : 5 alphabets between Y and E.

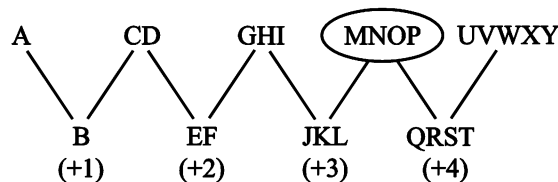
E – I : 3 alphabets between E and I.

I – K : 1 alphabet between I and K.

Hence, the correct option is (D).

1.38 (C)

In the alphabetical sequence, the missing word is as follows



Therefore, the missing word in the sequence is 'MNOP'.

Hence, the correct option is (C).

1.39 (B)

P, R, S, T, U is an arithmetic sequence.

They must have a common difference as,

$$R - P = S - R = T - S = U - T \dots (i)$$

(i) Multiplying equation (i) by 2,

$$2R - 2P = 2S - 2R = 2T - 2S = 2U - 2T$$

This shows that sequence (I) $\{2P, 2R, 2S, 2T, 2U\}$ is an arithmetic sequence.

- (ii) From sequence (II),
 $(R-3)-(P-3)=R-P$
 $(S-3)-(R-3)=S-R$
 $(T-3)-(S-3)=T-S$
 $(U-3)-(T-3)=U-T$

So, from equation (i),

$$(R-3)-(P-3)=(S-3)-(R-3)$$

$$=(T-3)-(S-3)=(U-3)-(T-3)$$

This shows that sequence (II) $\{P-3, R-3, S-3, T-3, U-3\}$ is also an arithmetic sequence.

$$\text{As } R-P=S-R$$

- (iii) From sequence (III),
 $R^2-P^2=(R-P)(R+P)$
 $R^2-P^2=(S-R)(R+P)$

$$\text{So, } R^2-P^2 \neq S^2-R^2$$

Therefore, sequence (III) is not an arithmetic sequence.

Hence, the correct option is (B).

1.40 (A)

$$\text{Given : } \log_x \left(\frac{5}{7} \right) = \frac{-1}{3}$$

$$x^{-1/3} = \frac{5}{7} \quad \{ \log_e m = n \Rightarrow e^n = m \}$$

$$x^{1/3} = \frac{7}{5}$$

$$x = \left(\frac{7}{5} \right)^3 = \frac{343}{125}$$

Hence, the correct option is (A).

1.41 (C)

The operators are defined as,

$$a \square b = \frac{a-b}{a+b}, \quad a \diamond b = \frac{a+b}{a-b}$$

and $a \rightarrow b = ab$

$$66 \square 6 = \frac{66-6}{66+6} = \frac{5}{6}$$

$$\text{and } 66 \diamond 6 = \frac{66+6}{66-6} = \frac{6}{5}$$

$$\text{So, } (66 \square 6) \rightarrow (66 \diamond 6)$$

$$= \frac{5}{6} \times \frac{6}{5} = 1$$

Hence, the correct option is (C).

1.42 3

The central number is the half of sum of numbers that are on the sides

$$5 = \frac{6+4}{2}$$

$$7 = \frac{(7+4)+(2+1)}{2} = \frac{11+3}{2}$$

$$8 = \frac{(1+9+2)+(1+2+1)}{2} = \frac{12+4}{2}$$

$$5 = \frac{(4+1)+(2+3)}{2} = \frac{5+5}{2}$$

So unknown number,

$$x = \frac{3+3}{2} = 3$$

Hence, the missing value is 3.

1.43 (B)

$$\text{Given : } a^2 + b^2 + c^2 = 1$$

$$\text{Since, } (a+b+c)^2 = a^2 + b^2 + c^2$$

$$+ 2(ab+bc+ca)$$

$$ab+bc+ca = \frac{(a+b+c)^2 - (a^2 + b^2 + c^2)}{2}$$

For minimum value of $ab+bc+ca$,

$$\text{Put } a+b+c=0,$$

$$\text{Minimum } (ab+bc+ca) = \frac{-1}{2}$$

$$(\text{Since, } a^2 + b^2 + c^2 = 1)$$

Only option (B) has minimum value as $\frac{-1}{2}$.

Hence, the correct option is (B).

1.44 (A)**Given :** $x > y > 1$ For $x > y > 1$, $\ln x > \ln y$ and also $e^x > e^y$ Since e^x and $\ln x$ are monotonically increasing function.

Example :

Assume $x = 3$, $y = 2$

(i) $\ln x > \ln y$

$\ln 3 = 1.0986$, $\ln 2 = 0.693$

$\ln x > \ln y$ is true

(ii) $e^x > e^y$

$e^3 = 20.08$, $e^2 = 7.38$

$e^x > e^y$ is true

(iii) $y^x > x^y$

$(2)^3 = 8$, $(3)^2 = 9$

$y^x > x^y$ is false

(iv) $\cos x > \cos y$

$\cos 3 = 0.998$

$\cos 2 = 0.999$

$\cos x > \cos y$ is false.

Hence, the correct option is (A).

1.45 (C)

Let $x = \log \tan 1^\circ + \log \tan 2^\circ + \dots + \log \tan 89^\circ$

$x = \log(\tan 1^\circ \times \tan 2^\circ \times \dots \times \tan 89^\circ)$

{ Since, $\log m + \log n = \log(mn)$

and $\tan(90^\circ - \theta) = \cot \theta$,

$\tan 89^\circ = \tan(90^\circ - 1^\circ) \}$

$x = \log(\tan 1^\circ \times \tan 2^\circ \times \dots \times \tan 45^\circ$

$\times \cot 45^\circ \times \dots \times \cot 2^\circ \times \cot 1^\circ)$

$\left[\cot \theta = \frac{1}{\tan \theta} \Rightarrow \tan \theta \cot \theta = 1 \right]$

$x = \log(1 \times 1 \times 1 \times \dots \times 1) = \log(1) = 0$

Hence, the correct option is (C).

1.46 4536**Given :**

(i) No number can start with zero.

(ii) Repetition is not allowed.

In thousandth place, 9 digits excepts 0 can be placed.

In hundredth place, 9 digits can be placed (including 0, excluding the one used in thousandth place).

In tenth place, 8 digit can be placed (excluding the ones used in thousandth and hundredth place)

In ones place, 7 digits can be placed (excluding the ones used in thousandth, hundredth and tenth place)

Total number of combinations,

$= 9 \times 9 \times 8 \times 7 = 4536$

Hence, 4 digit numbers that can be formed are **4536**.**1.47 (C)**

Given : $q^{-a} = \frac{1}{r}$, $r^{-b} = \frac{1}{s}$, $s^{-c} = \frac{1}{q}$,

$q^a = r$, $r^b = s$, $s^c = q$

Taking log on both sides,

$\log q^a = \log r$, $\log r^b = \log s$,

$\log s^c = \log q$

$a \times \log q = \log r \Rightarrow a = \frac{\log r}{\log q}$

$b \times \log r = \log s \Rightarrow b = \frac{\log s}{\log r}$

$c \times \log s = \log q \Rightarrow c = \frac{\log q}{\log s}$

So, $a \times b \times c = \frac{\log r}{\log q} \times \frac{\log s}{\log r} \times \frac{\log q}{\log s} = 1$

Hence, the correct option is (C).

1.48 (C)

Given :

$$(9 \text{ inches})^{1/2} = (0.25 \text{ yards})^{1/2}$$

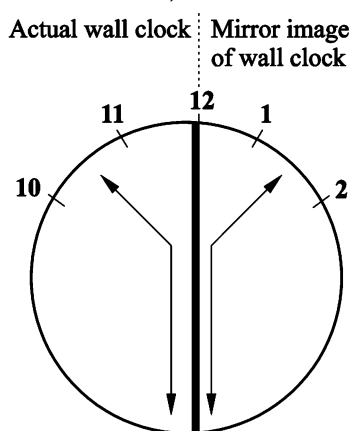
Squaring both sides,

$$9 \text{ inches} = 0.25 \text{ yards.}$$

Hence, the correct option is (C).

1.49 (D)

The following diagram, shows the clock when its reflection seemed like 1 : 30, two and a quarter hours (2 hr. and 15 min) back.



Mirror image of 1 : 30 is 10 : 30

So, the actual current time shown by the clock will be,

$$(10 : 30) + (2 : 15) = 12 : 45$$

Hence, the correct option is (D).

1.50 (C)

In the given set of numbers, all are perfect squares but 97 is not.

$$324 \text{ is square of } 18 \Rightarrow (18)^2 = 324$$

$$441 \text{ is square of } 21 \Rightarrow (21)^2 = 441$$

$$64 \text{ is square of } 8 \Rightarrow (8)^2 = 64$$

97 is not the square of any number

Hence, the correct option is (C).

1.51 (B)

In the group of given numbers, all are prime numbers except 33.

33 has [1, 3, 11 and 33] as its factors.

Hence, the correct option is (B).

Key Point

A prime number has only two factors '1' and 'the number itself'.

1.52 (C)

$$\text{Given : } |9y - 6| = 3$$

$$9y - 6 = \pm 3$$

$$\text{Since, } |x| = \pm x$$

Taking positive value,

$$9y - 6 = 3$$

$$y = 1$$

Put $y = 1$,

$$y^2 - \frac{4y}{3} = 1^2 - \frac{4(1)}{3} = 1 - \frac{4}{3} = -\frac{1}{3}$$

Taking negative value,

$$9y - 6 = -3$$

$$y = \frac{1}{3}$$

Put $y = \frac{1}{3}$,

$$y^2 - \frac{4y}{3} = \left(\frac{1}{3}\right)^2 - \frac{4\left(\frac{1}{3}\right)}{3} = \frac{1-4}{9} = -\frac{1}{3}$$

Thus, in both cases, the obtained value of

$$\left[y^2 - \frac{4}{3}y\right] \text{ is } -\frac{1}{3}.$$

Hence, the correct option is (C).

1.53 7

Cyclicity of 1 is always 1.

Cyclicity of 6 is always 6.

Cyclicity of 3 is,

$$3^1 \rightarrow 3$$

$$3^2 \rightarrow 9$$

$$3^3 \rightarrow 7$$

$$3^4 \rightarrow 1$$

$$\text{Unit digit of } 211^{870} = 1$$

$$\text{Unit digit of } 146^{127} = 6$$

Unit digit of $3^{424} = (3^4)^{106} = 1$

Hence, the correct answer is $1 + 6 \times 1 = 7$.

1.54 (A)

Given :

- (i) Sum of digits of two digit number is 12
- (ii) Reverse of the two-digit number is greater than original number by 54.

Method 1

The new number formed by reversing the digits is greater than the original number is possible in options A and B only because reverse of 93 will be a smaller number and reverse of 66 will be similar to itself.

From option (A) :

Sum of two digits in the number $= 3 + 9 = 12$

After reversing the two digits number $= 93$

The difference between the new number formed and original number $= 93 - 39 = 54$

Hence, the correct option is (A).

Method 2

Let original number be xy .

Then, $(10x + y) + 54 = 10y + x$

$$9x + 54 = 9y$$

$$9x - 9y = -54$$

$$x - y = -6 \quad \dots (i)$$

$$\text{Also, } x + y = 12 \quad \dots (ii)$$

From equations (i) and (ii),

$$x = 3, y = 9$$

Hence, the correct option is (A).

Method 3

Let the digit at one's place will be x and ten's place will be $(12 - x)$.

$$\begin{aligned} \text{Hence, the original number} &= 10(12 - x) + x \\ &= 120 - 10x + x \\ &= 120 - 9x \quad \dots (i) \end{aligned}$$

The number obtained by interchanging the digits

$$= 10x + 12 - x$$

$$= 9x + 12$$

As per given condition,

$$9x + 12 = 54 + 120 - 9x$$

$$9x + 9x = 174 - 12$$

$$18x = 162$$

$$x = 9$$

From equation (i),

$$\text{Original number} = 120 - 9 \times 9 = 120 - 81 = 39$$

Hence, the correct option is (A).

1.55 (C)

Total number of 3 digit numbers

$$= 900 [100 \text{ to } 999]$$

Numbers which have 1 on immediate right of 2

$$\{210, 211, \dots, 219\} = 10 \text{ numbers}$$

$$\text{and } \{121, 221, 321, \dots, 921\} = 9 \text{ numbers}$$

So, number of 3 digit number such that digit 1 is never on the immediate right of 2 is given by,

$$900 - (10 + 9) = 881$$

Hence, the correct option is (C).

1.56 (D)

Given : $X = y \times 162$

Method 1

Checking from the options,

Option (A) :

$$X = 24 \times 162 = 3888$$

$$(X)^{1/3} = 15.7$$

Incorrect option.

Option (B) :

$$X = 27 \times 162 = 4374$$

$$(X)^{1/3} = 16.3$$

Incorrect option.

Option (C) :

$$X = 32 \times 162 = 5184$$

$$(X)^{1/3} = 17.3$$

Incorrect option.

Option (D) :

$$X = 36 \times 162 = 5832$$

$$(X)^{1/3} = 18$$

Hence, the correct option is (D).

Method 2

Take the prime factor of $162 = 2 \times 81 = 2 \times 9 \times 9$
 $= 2 \times 3 \times 3 \times 3 \times 3$

Hence, to make it perfect cube, the value of y should be $y = 2 \times 2 \times 3 \times 3 = 36$

Hence, the correct option is (D).

1.57 (C)

To find a k -digit number that does NOT contain the digits 0, 5 or 9.

The total number of ways to fill any place
 $= 10 (0, 1, 2, 3, 4, 5, 6, 7, 8, 9)$

Now, if this number does not contain (0, 5, 9) then there are 7 other ways to fill each of the k digits.

These remaining digits are following :

1, 2, 3, 4, 6, 7, 8

Probability of filling these 7 digits will be,

$$= \left(\frac{7}{10}\right)^k = (0.7)^k$$

Hence, the correct option is (C).

1.58 (A)Let the number X is 47×10^{28} .

$$\text{Then, } X^3 = 47^3 \times 10^{84} = 103823 \times 10^{84}$$

$$X^3 = 1.03823 \times 10^{89}$$

So, there are 90 i.e. (1 + 89) digits in X^3 .

Hence, the correct option is (A).

1.59 (B)

$$\text{Given : } 81 \times \left(\frac{16}{25}\right)^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$$

$$\left[\left(9 \times \frac{4}{5}\right)^2\right]^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$$

$$\left[\left(\frac{36}{5}\right)^{x+2}\right]^2 \div \left[\left(\frac{3}{5}\right)^{x+2}\right]^2 = 144$$

$$\left[\frac{36}{5} \times \frac{5}{3}\right]^{x+2} = 12$$

$$12^{x+2} = 12$$

$$\text{So, } x + 2 = 1$$

$$x = -1$$

Hence, the correct option is (B).

1.60 (D)**Given :**

$$\begin{array}{r} 5 \quad \_ \quad \_ \quad \_ \quad \_ \\ - 4 \quad 8 \quad \_ \quad 8 \quad 9 \\ \hline 1 \quad 1 \quad 1 \quad 1 \end{array}$$

Case (i) :

$$\begin{array}{r} 5 \quad 0 \quad 0 \quad 0 \quad 0 \\ - 4 \quad 8 \quad 8 \quad 8 \quad 9 \\ \hline 1 \quad 1 \quad 1 \quad 1 \end{array}$$

Sum of missing digits = $0 + 0 + 0 + 0 + 8$

$$S = 8$$

Case (ii) :

$$\begin{array}{r} 5 \quad 0 \quad 1 \quad 0 \quad 0 \\ - 4 \quad 8 \quad 9 \quad 8 \quad 9 \\ \hline 1 \quad 1 \quad 1 \quad 1 \end{array}$$

Sum of missing digits = $0 + 1 + 0 + 0 + 9$

$$S = 10$$

Since, the sum can either be 8 or 10, therefore it cannot be determined.

Hence, the correct option is (D).

1.61 (D)**Given :**(i) a and b are integers.(ii) $a - b$ is even.

Let $a = 5$ and $b = 3$ where both are integers and their difference is even.

From option (A) :

$$ab = 15 \quad [\text{not even, incorrect}]$$

From option (B) :

$$a^2 + b^2 + 1 = 25 + 9 + 1 = 35$$

[not even, incorrect]

From option (C) :

$$a^2 + b + 1 = 25 + 3 + 1 = 29$$

[not even, incorrect]

From option (D) :

$$ab - b = 15 - 3 = 12 \quad [\text{even}]$$

Hence, the correct option is (D).

1.62 (B)

Cyclicity of 1 is always 1.

Cyclicity of 2 is,

$$2^1 \rightarrow 2$$

$$2^2 \rightarrow 4$$

$$2^3 \rightarrow 8$$

$$2^4 \rightarrow 6$$

$$2^5 \rightarrow 2$$

Cyclicity of 3 is,

$$3^1 \rightarrow 3$$

$$3^2 \rightarrow 9$$

$$3^3 \rightarrow 7$$

$$3^4 \rightarrow 1$$

Cyclicity of 4 is,

$$4^1 \rightarrow 4$$

$$4^2 \rightarrow 6$$

Unit digit of $2171^7 = 1$

Unit digit of $2172^9 = 2$

Unit digit of $2173^{11} = 7$

Unit digit of $2174^{13} = 4$

Therefore, the last digit of

$$(2171)^7 + (2172)^9 + (2173)^{11} + (2174)^{13}$$

$$= 1 + 2 + 7 + 4 = 14$$

Hence, the correct option is (B).

1.63 (B)

Divisibility rule : For a given number, if sum of digits is divisible by 3, then the number will be divisible by 3.

Number is 7 1 5__4 2 3

Let, the missing number is x .

Now we check whether the sum of number is divisible by 3 or not.

$$7 + 1 + 5 + x + 4 + 2 + 3 = 22 + x$$

From options :

When $x = 2$,

$$22 + 2 = 24 \quad (\text{which is divisible by 3})$$

When $x = 5$,

$$22 + 5 = 27 \quad (\text{which is divisible by 3})$$

Here we see that the value of x satisfied in above equation is 2.

Note : Here in this question only option (B) and (C) are satisfying the equation i.e. (2 and 5). But smallest number is asked in question. So, correct answer is 2.

Hence, the correct option is (B).

1.64 (D)

Given series, $1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \frac{1}{256} + \dots$ is in G.P. form.

Geometric progression (G.P.) form

$$= a_1 + a_1 r + a_1 r^2 + \dots$$

Here, the first term is $a_1 = 1$ and the ratio of 2nd

and 1st term is $r = \frac{1}{4}$ ($r < 1$).

The sum of infinite G.P. series is given by,

$$S = \frac{a_1}{1-r} = \frac{1}{1-\frac{1}{4}} = \frac{4}{3}$$

Hence, the correct option is (D).

1.65 (C)

Given : $f(k) = \frac{(k+2)^2}{k-3}$

From options :

When $k = 4$, $f(k) = \frac{(4+2)^2}{4-3} = \frac{36}{1} = 36$

which is integer

When $k = 8$, $f(k) = \frac{(8+2)^2}{8-3} = \frac{10^2}{5} = 20$

which is integer

When $k = 28$, $f(k) = \frac{(28+2)^2}{28-3} = \frac{30^2}{25} = 36$

which is integer

When $k = 18$, $f(k) = \frac{(18+2)^2}{18-3} = \frac{20^2}{15} = 26.67$,

which is decimal number

When $k = 10$, $f(k) = \frac{(10+2)^2}{10-3} = \frac{12^2}{7} = 20.57$

which is decimal number

When $k = 16$, $f(k) = \frac{(16+2)^2}{16-3} = \frac{18^2}{13} = 24.92$

which is decimal number

When $k = 26$, $f(k) = \frac{(26+2)^2}{26-3} = \frac{28^2}{23} = 34.08$

which is decimal number

Hence, the correct option is (C).

1.66 (D)

Given :

(i) a and b are integer.

(ii) $a + a^2b^3$ is odd

So, $a(1 + ab^3)$ is also odd.

Method 1

Since, multiplication of odd and odd number is odd.

Therefore, a and $(1 + ab^3)$ will be odd. If $1 + ab^3$ is odd, then ab^3 will be even.

Since, a is odd, so ab^3 to be even, b must be even.

Therefore, a is odd and b is even.

Hence, the correct option is (D).

Method 2

Checking from the options :

Options	a	b	$a + a^2b^3$ (Odd)
(A)	1(odd)	3(odd)	28(incorrect)
(B)	2(even)	4(even)	258(incorrect)
(C)	2(even)	1(odd)	6(incorrect)
(D)	1(odd)	2(even)	9(correct)

Hence, the correct option is (D).

1.67 (B)

Given :

(i) Sum of a two-digit number is 9.

(ii) When the number is subtracted by 45, the digits of the number are interchanged.

Let the two digit number be xy .

Then $x + y = 9$... (i)

and $(10x + y) - 45 = 10y + x$

$x - y = 5$... (ii)

From equation (i) and (ii),

$x = 7, y = 2$

So, the number is 72

Hence, the correct option is (B).

1.68 (B)

Given : Series is BC, FGH, LMNO,.....

It is clear from the given series that each term has one more alphabet previous each term.

Also, gap between each term increases by one alphabet as well.

BC, DE, FGH, IJK, LMNO, PQRS

So, next term will be TUVWX.

Hence, the correct option is (B).

1.69 (C)

Given :

Sequence of numbers $a_1, a_2, \dots, a_n$

$$\text{Where } a_n = \frac{1}{n} - \frac{1}{n+2}$$

$$\text{So, } a_1 = 1 - \frac{1}{3}, a_2 = \frac{1}{2} - \frac{1}{4}, a_3 = \frac{1}{3} - \frac{1}{5}$$

$$\text{Sum} = \left(1 - \frac{1}{3}\right) + \left(\frac{1}{2} - \frac{1}{4}\right) + \dots + \frac{1}{50} - \frac{1}{52}$$

$$\text{Sum} = \left(1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{50}\right) - \left(\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \dots + \frac{1}{52}\right)$$

$$\text{Sum} = 1 + \frac{1}{2} - \frac{1}{51} - \frac{1}{52}$$

$$\text{Sum} = 1 + \frac{1}{2} - \left(\frac{1}{51} + \frac{1}{52}\right)$$

Hence, the correct option is (C).

1.70 (A)

Given : $\log a + \log b + \log c = 0$

$$\log abc = 0$$

$$abc = 1$$

Since, a, b and c are non-negative numbers and their product is 1, their sum can not be negative or 0.

So, option (C) and (D) are incorrect.

Since, a, b and c are greater than equal to zero, their sum can not be 1.

So, if $a + b + c = 1 + 1 + 1 = 3$ [option (A)]

Hence, the correct option is (A).

1.71 (B)

Given :

$$(i) \quad \underbrace{a + a + \dots + a}_{n \text{ times}} = a^2 b$$

$$n \times a = a^2 b$$

$$n^2 a^2 = a^4 b^2 \quad \dots (i)$$

$$(ii) \quad \underbrace{b + b + \dots + b}_{m \text{ times}} = ab^2$$

$$m \times b = ab^2$$

$$m^2 b^2 = a^2 b^4 \quad \dots (ii)$$

$$\underbrace{m + m + \dots + m}_{n \text{ times}} \times \underbrace{n + n + \dots + n}_{m \text{ times}} = m \times n \times n \times m$$

$$\underbrace{m + m + \dots + m}_{n \text{ times}} \times \underbrace{n + n + \dots + n}_{m \text{ times}} = m^2 n^2$$

Multiplying equation (i) and (ii),

$$m^2 n^2 a^2 b^2 = a^6 b^6$$

$$m^2 n^2 = a^4 b^4$$

Hence, the correct option is (B).

1.72 (B)

Given : Faulty clock gains 15 minutes every 24 hours

On 11th July at 9 am, clock is synchronized to the correct time.

From 11th July, 9 am to 15th July 9 am = 4 days

Total minutes gain = $15 \times 4 = 60 \text{ min} = 1 \text{ hour}$.

Every hour the clock gains $\frac{15}{24} \text{ min} = 0.625 \text{ min}$

From 15th July 9 am to 15th July 2 pm, total minutes gain = $5 \times 0.625 \text{ min} = 3.125 \text{ min}$.

So, from 11th July at 9 am to 15th July 2 pm, clock has gain 63.125 minutes, which means the correct time is 12.57 pm or approximately 12:58 pm.

Hence, the correct option is (B).

1.73 (C)

$$\text{Given : } p^{-x} = \frac{1}{q}$$

$$p^x = q \quad \dots (i)$$

Similarly, $q^y = r$... (ii)

$r^z = p$... (iii)

From equation (i), (ii) and (iii)

$$p = q = r = 1$$

And $x = y = z = 1$

Thus, the product of $xyz = 1 \times 1 \times 1 = 1$.

Hence, the correct option is (C).

1.74 (C)

The LCM of 20, 42 & 76 are :

$$20 = 2 \times 2 \times 5$$

$$42 = 2 \times 3 \times 7$$

$$76 = 2 \times 2 \times 19$$

$$\begin{aligned} \text{LCM} &= 2 \times 2 \times 3 \times 5 \times 7 \times 19 \\ &= 7980 \end{aligned}$$

Thus, the smallest natural number which when divided either by 20 or by 42 or by 76 leaves a remainder of 7 in each case = $7980 + 7 = 7987$

Hence, the correct option is (C).

Key Point

The smallest natural number which divided by 20, or by 42 or by 76 must be its "Least common multiple".

1.75 (B)

$$\begin{array}{ccccccccccc} 2, & 12, & 60, & 240, & 720, & 1440, & \_, & 0 \\ \swarrow & \swarrow & \swarrow & \swarrow & \swarrow & \swarrow & \swarrow & \swarrow \\ 2 \times 6 & 12 \times 5 & 60 \times 4 & 240 \times 3 & 720 \times 2 & 1440 \times 1 & 1440 \times 0 \end{array}$$

So, 1440 is the missing number.

Hence, the correct option is (B).

1.76 (B)

Given :

The number of Male = M

The number of Female = F

$$M + F = 300$$

According to condition

Total money given by philanthropist

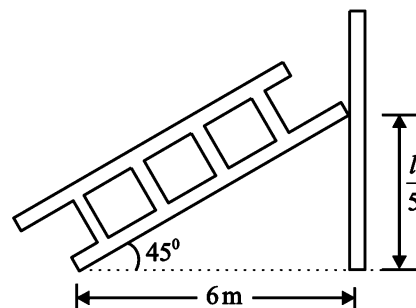
$$= \frac{8}{9}M \times 750 + \frac{2}{3}F \times 1000$$

$$\begin{aligned} &= \frac{6000}{9}M + \frac{2000}{3}F \\ &= \frac{6000}{9} \times 300 = 2,00,000 \end{aligned}$$

Hence, the correct option is (B).

1.77 (D)

According to given data, the figure can be drawn as shown below,



Let length of pole be l (in meters).

$$\text{Then, } \tan 45^\circ = \frac{l/5}{6}$$

$$\frac{l}{5} = 6 \Rightarrow l = 30 \text{ m}$$

Hence, the correct option is (D).

1.78 (C)

Given :

- (i) Total budget = 3000 USD.
- (ii) P and Q started working from 8 AM.
- (iii) P stopped working when hour hand moved by 210 degrees.
- (iv) Q stopped working when the hour hand moved by 240 degrees.
- (v) P took two tea breaks of 15 minutes.
- (vi) Q took only one lunch break for 20 minutes.

The angle made by hour hand of watch in 1 hour

$$= \frac{360^\circ}{12} = 30^\circ$$

$$\text{Working hour of } P = \frac{210^\circ}{30^\circ} = 7 \text{ hrs.}$$

P took two breaks of 15 min = 0.5 hrs.

Net working hours of $P = 7 - 0.5 = 6.5$

$$P = \frac{13}{2} \text{ hrs.}$$

Working hour of $Q = \frac{240^0}{30^0} = 8 \text{ hrs.}$

Q took one break of 20 min = $\frac{1}{3}$ hrs.

Net working hour of $Q = 8 - \frac{1}{3} = \frac{23}{3}$ hrs.

Total working hour of P and Q

$$= \frac{13}{2} + \frac{23}{3} = \frac{39+46}{6} = \frac{85}{6} \text{ hrs.}$$

Amount paid for one hour = USD 200

$$\text{Total amount paid} = \frac{200 \times 85}{6} = \frac{8500}{3}$$

Amount remained

$$= 3000 - \frac{8500}{3} = \frac{500}{3} = 166.66 \text{ USD}$$

Hence, the correct option is (C).

1.79 (B)

Given : Two sets $X = \{1, 2, 3\}$ and $Y = \{2, 3, 4\}$

Therefore, set of all possible fractions

$$Z = \left\{ \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{2}{2}, \frac{2}{3}, \frac{2}{4}, \frac{3}{2}, \frac{3}{3}, \frac{3}{4} \right\}$$

Where the numerators belongs to set X and the denominators belong to set Y .

$$Z = \left\{ \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{2}{4}, \frac{2}{3}, \frac{2}{2}, \frac{3}{4}, \frac{3}{2}, \frac{3}{3} \right\}$$

$\downarrow$ $\downarrow$
 0.2 1.5
 Minimum Maximum

The required product = $\frac{1}{4} \times \frac{3}{2} = \frac{3}{8}$

Hence, the correct option is (B).

1.80 (C)

$$343 = 7^3$$

$$1331 = 11^3$$

$$4913 = 17^3$$

Since 7, 11, 17 are prime numbers so checking from the options,

$$2197 = 13^3$$

Hence, the correct option is (C).

1.81 (B)

Integers between 100 and 1000 all of whose digits are even = 100

Since, 100–199 → No integers

200–300 → 25 integers

[200, 202, 204, 206, 208, 220, 222, 224, 226, 228, 240, 242, 246, 248, 260, 262, 264, 266, 268, 280, 282, 284, 286, 288].

Similarly, 400–500 → 25 integers

600–700 → 25 integers

800–900 → 25 integers

Total → 100 integers

Hence, the correct option is (B).

1.82 (C)

- (i) No two odd or even numbers are next to each other.
- (ii) The second number from the left is exactly half of the left most number.
- (iii) The middle number is exactly twice the right most number.

According to the first direction, odd numbers will be at even positions and even numbers will be at odd positions.

Number	2/4/10	5/7	2/4/10	5/7	2/4/10
Position	I	II	III	IV	V

According to second direction,

Number	10	5	2/4	7	2/4
Position	I	II	III	IV	V

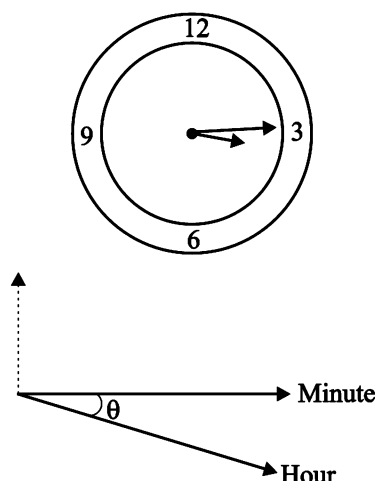
According to third direction,

Number	10	5	4	7	2
Position	I	II	III	IV	V

Therefore, the second number from the right is 7.
Hence, the correct option is (C).

1.83 (C)

Positions of hour and minute hands of water is shown in figure



The displacement of hour hand during every 12 hours is 360° .

The required angle between the hands at quarter past 3⁰ is equal to the angle made by hour hand in 15 minutes as the minute hand is now at the same position where, the hour hand was present at 3⁰ clock.

In 12×60 min, angle made = 360°

In 1 min, angle made = $\left(\frac{360}{12 \times 60}\right)^\circ$

In 15 min, angle made = $\left(\frac{360}{12 \times 60} \times 15\right)^\circ = 7.5^\circ$

Hence, the correct option is (C).

1.84 (D)

Number of ways by which 37 can appear in numbers 1000 to 9999 are shown below,

9 ways 10 ways
(1 to 9) (0 to 9) $\underline{3} \quad \underline{7} \Rightarrow 9 \times 10 = 90 \quad \dots(i)$

9 ways 10 ways
(1 to 9) $\underline{3} \quad \underline{7} \quad (0 \text{ to } 9) \Rightarrow 9 \times 10 = 90 \quad \dots(ii)$

9 ways 10 ways 10 ways
 $\underline{3} \quad \underline{7} \quad (0 \text{ to } 9) \quad (0 \text{ to } 9) \Rightarrow 10 \times 10 = 100 \quad \dots(iii)$

There is no common numbers in case (i) - case (ii) or in case (ii) - case (iii) but there exist a common number between case (iii) and case (i), that is 3737.

So, if the total number of numbers is asked in which 37 appears in this sequence, then the answer would be,

$$90 + 90 + 100 - 1 = 279$$

Which is as given in IIT answer key but the required value is asked only for repetition of 37, not the numbers which contains 37, so in the number "3737", 37 must be counted 3 times, then the correct answer would be,

$$90 + 90 + 100 = 280$$

IIT has changed their answer for this question from option (C) to option (D) in the final answer key, but they do not considered it as MTA.

So, students must read the statement given in the question, before going to select the correct option in such type of problems.

1.85 (D)

Given : $S_n = 8 + 88 + 888 + \dots + n$

$$S_n = 8(1 + 11 + 111 + \dots)$$

$$S_n = \frac{8}{9}(9 + 99 + 999 + \dots)$$

$$S_n = \frac{8}{9}[(10 - 1) + (100 - 1) + (1000 - 1) + \dots]$$

$$S_n = \frac{8}{9}[(10 + 100 + 1000 + \dots) - n]$$

$$S_n = \frac{8}{9}[(10^1 + 10^2 + 10^3 + \dots) - n]$$

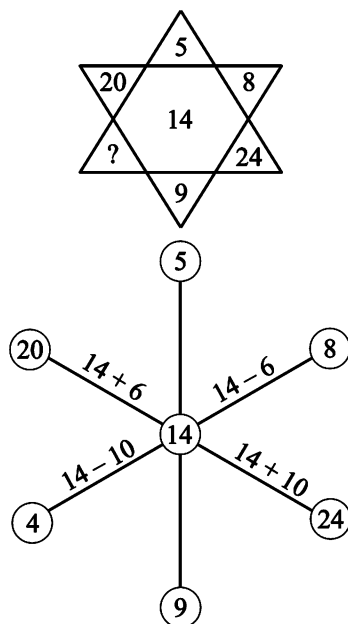
$$S_n = \frac{8}{9} \left[\left(\frac{10(10^n - 1)}{10 - 1} \right) - n \right] \left\{ \because S_n = \frac{a(r^n - 1)}{r - 1} \right\}$$

$$\therefore S_n = \frac{80}{81}(10^n - 1) - \frac{8}{9}n$$

Hence, the correct option is (D).

1.86 (C)**Codes :**

- 1 - a
2 - b
3 - c
⋮ - ⋮
26 - z



Here, 4 is denoted as d .

Hence, the correct option is (C).

1.87 (D)

Given : Seven numbers are inserted between 2 and 34 such that the nine numbers are in AP.

Sum of n terms in an AP = $\frac{n}{2}$ [First term + Last term]

$$\text{Sum of 9 terms} = \frac{9}{2}(2 + 34) = 162$$

$$\text{Sum of 7 terms inserted} = 162 - (2 + 34) = 126$$

Hence, the correct option is (D).

1.88 (D)

The difference between the sum of first ' $2n$ ' natural numbers and the sum of the first ' n ' odd positive integers are as follows :

First ' $2n$ ' natural numbers are as follows :

$$1, 2, 3, \dots, 2n$$

$$\begin{aligned} \text{Sum} &= \frac{\text{Number of terms}}{2} \times [\text{First term} \times 2 \\ &+ (\text{Number of terms} - 1) \times \text{Common difference}] \\ &= \frac{2n}{2} [2 \times 1 + (2n - 1) \times 1] \end{aligned}$$

$$= n(2 + 2n - 1) = n(2n + 1) = 2n^2 + n$$

First ' n ' odd positive integers are : 1, 3, 5, ..., n

$$\begin{aligned} \text{Sum} &= \frac{n}{2} [2 \times 1 + (n - 1) \times 2] \\ &= \frac{n}{2} [2 + 2n - 2] = n^2 \end{aligned}$$

$$\text{Difference} = 2n^2 + n - n^2 = n^2 + n$$

Hence, the correct option is (D).

1.89 (A)

Given : $\frac{p}{q} + \frac{q}{p} = 3$

By squaring above equation we get,

$$\frac{p^2}{q^2} + \frac{q^2}{p^2} + 2 \frac{p}{q} \cdot \frac{q}{p} = 9$$

$$\frac{p^2}{q^2} + \frac{q^2}{p^2} + 2 = 9$$

$$\frac{p^2}{q^2} + \frac{q^2}{p^2} = 9 - 2 = 7$$

Hence, the correct option is (A).

1.90 (B)

Given :

$$\text{Divisor} = (11^{13} + 11)$$

Writing in the form of $(a + b)$

Where, $a = 11^{13}$ and $b = 1$

The possibilities of dividend $(a + b)$ as one of the factor :

$$(a + b)^2 = (a + b)(a + b) \quad \dots(i)$$

$$(a^2 - b^2) = (a + b)(a - b) \quad \dots(ii)$$

$$(a^4 - b^4) = (a^2 + b^2)(a + b)(a - b) \dots \text{(iii)}$$

$$(a + b)^3 = (a + b)(a^2 + b^2) \dots \text{(iv)}$$

Checking from options :

Option (A) $11^{26} + 1$: Not following any possibility. So it is incorrect.

Option (B) $11^{52} - 1$: Following possibility of $(a^4 - b^4)$ i.e. $[(11^{13})^4 - 1^4]$. So it is correct.

Option (C) $11^{39} - 1$: Not following any possibility. So it is incorrect.

Option (D) $11^{33} + 1$: Not following any possibility. So it is incorrect.

Hence, the correct option is (B).

1.91 (A)

Given : $p \oplus q = \frac{p^2 + q^2}{pq}$

$$x \oplus y = \frac{x^2 + y^2}{xy} \dots \text{(i)}$$

and $p \odot q = \frac{p^2}{q}$

$$2 \odot 2 = \frac{2^2}{2} = 2 \dots \text{(ii)}$$

From equation (i) and (ii),

$$\frac{x^2 + y^2}{xy} = 2$$

$$x^2 + y^2 - 2xy = 0$$

$$(x - y)^2 = 0$$

Thus, $x = y$ satisfy the condition.

Hence, the correct option is (A).

1.92 (B)

Given : " $\oplus$ " means " $\times$ "

" $\odot$ " means " $-$ "

As per the given data the new equation will be,

$$[9 - (6 \times 7)] - [7 \times 1]$$

$$-33 - 7 = -40$$

Hence, the correct option is (B).

1.93 (A)

Given :

" $\oplus$ " means " $-$ ",

" $\otimes$ " means " $\div$ ",

" Δ " means " $+$ ",

" ∇ " means " $\times$ ",

As per the data new equation will be :

$$+2 - 3 + ((4 \div 2) \times 4)$$

$$2 - 3 + 8 = 7$$

Hence, the correct option is (A).

1.94 (B)

Given :

$$\oplus \div \odot = 2,$$

$$\oplus \div \Delta = 3,$$

$$\odot + \Delta = 5,$$

By given information we can conclude

$$\odot = \frac{\oplus}{2} \text{ and } \Delta = \frac{\oplus}{3}$$

Put these values on $\odot + \Delta = 5$

We get, $\frac{\oplus}{2} + \frac{\oplus}{3} = 5$

$$\frac{3\oplus + 2\oplus}{6} = 5$$

$$5\oplus = 30$$

$$\oplus = 6$$

By equation,

$$\oplus \div \Delta = 3$$

↓

$$6 \div 2 = 3$$

By equation,

$$\Delta \div \otimes = 10$$

↓

$$2 \times 5 = 10$$

So, that $(\otimes - \oplus)^2$

$$(5 - 6)^2 = 1$$

Hence, the correct option is (B).

$$F_5 = F_4 + F_3 \quad \dots(\text{iii})$$

$$F_6 = F_5 + F_4 \quad \dots(\text{iv})$$

$$F_7 = F_6 + F_5 \quad \dots(\text{v})$$

For put the value of F_7 in equation (v), we get

$$60 = 37 + F_5$$

$$F_5 = 23$$

Now, put the value of F_5 in equation (iv), we get

$$F_6 = F_5 + F_4$$

$$37 = 23 + F_4$$

$$F_4 = 14$$

Now, put value at F_4 is equation (iii), we get

$$F_5 = F_4 + F_3$$

$$23 = 14 + F_3$$

$$F_3 = 9$$

Now, put the value of F_3 in equation (ii), we get

$$14 = 9 + F_2$$

$$F_2 = 5$$

Now, put the value of F_2 in equation (i), we get

$$F_3 = F_2 + F_1$$

$$9 = 5 + F_1$$

$$F_1 = 4$$

Hence, the correct option is (A).

1.100 (A)

Given : There are two in equalities

$$p^2 - 4q < 4$$

$$3p + 2q < 6$$

Where, p and q are positive integers.

$$3p + 2q < 6$$

$$6p + 4q < 12$$

$$4q < 12 - 6p \quad \dots(\text{i})$$

$$p^2 - 4q < 4$$

$$p^2 - 4 < 4q \quad \dots(\text{ii})$$

$$p^2 - 4 < 12 - 6p$$

$$p^2 + 6p - 16 < 0$$

$$p^2 + 8p - 2p - 16 < 0$$

$$p(p+8) - 2(p+8) < 0$$

$$(p+8)(p-2) < 0$$

$$p = (-8, 2)$$

Since p is positive integer. So, $p = 1$

Using this in equation (i)

$$4q < 12 - 6p \quad (p = 1)$$

$$4q < 6$$

$$q < \frac{3}{2}$$

$$q = 1$$

The value of $p + q$ is $1 + 1 = 2$.

Hence, the correct option is (A).

1.101 (A)

Given :

$$3^{999} \times 7^{1000} = (3^4)^{249} \times 3^3 \times (7^4)^{25} = 1 \times 27 \times 1$$

Unit digit value = 7

Hence, the correct option is (A).

1.102 (A)

Given :

$$\begin{aligned} 3^{199} - 3^{196} &= 3^{196} (3^3 - 1) \\ &= 3^{196} \times 26 = 3^{190} \times 13^1 \times 2^1 \end{aligned}$$

Prime factors = 3, 13, 2

Greatest value of prime factor = 13

Hence, the correct option is (A).

1.103 (A)

Sum of first two consecutive odd numbers is

$$1 + 3 = 4 = 2^2$$

Sum of first three consecutive odd numbers is

$$1 + 3 + 5 = 9 = 3^2$$

Sum of first four consecutive odd numbers is

$$1 + 3 + 5 + 7 = 16 = 4^2$$

After analyzing the given sequence. We can observe that each number is the multiplication of previous number with 2 and adding one to the result obtained.

$$\begin{aligned}\text{i.e., } 1 \times 2 + 1 &= 3 \\ 3 \times 2 + 1 &= 7 \\ 7 \times 2 + 1 &= 15 \\ 15 \times 2 + 1 &= \boxed{31} \\ 31 \times 2 + 1 &= 63 \\ 63 \times 2 + 1 &= 127 \\ 127 \times 2 + 1 &= 255\end{aligned}$$

Hence, the possible value of x in the given sequence is 31.

Hence, the correct option is (D).

1.107 (C)

There is 50 min duration between 12:05:00 to 12:55:00 hours we know that in every minute, minute hand crosses second hand. So, during these 50 min. they will cross each other 50 times. Hence, the correct option is (C).

1.108 (A)

Sum of first two consecutive odd numbers is

$$1 + 3 = 4 = 2^2$$

Sum of first three consecutive odd numbers is

$$1 + 3 + 5 = 9 = 3^2$$

Sum of first four consecutive odd numbers is

$$1 + 3 + 5 + 7 = 16 = 4^2$$

Sum of first five consecutive odd numbers is

$$1 + 3 + 5 + 7 + 9 = 25 = 5^2$$

Hence, we can conclude that the sum of first n consecutive odd numbers is n^2

$$\text{i.e., } \underbrace{1 + 3 + 5 + \dots}_{n \text{ numbers}} = n^2$$

Sum of first 20 consecutive odd numbers is $= 20^2$

$$\underbrace{1 + 3 + 5 + 7 + \dots}_{20 \text{ numbers}} = 20^2$$

The sum of first 20 consecutive positive odd numbers divided by

$$20^2 = \frac{20^2}{20^2} = 1$$

Hence, the correct option is (A).

1.109 (A)

Given : Set : {19, 37, 21, 17, 23, 29, 31, 11}

In the given set all the number are prime number except '21'.

Hence, '21' does not fit in this set.

Hence, the correct option is (A).

1.110 (C)

Given : Series of numbers

$$1, 1, 2, 3, 6, 8, 13, 21 \dots\dots\dots$$

Fibonacci series: In Fibonacci series, every number is equal to the sum of previous two number of the series

$$\text{i.e. } 0, 1, 1, 2, 3, 5, 8, 13, 21 \dots\dots\dots$$

Expanding it as the sum of two previous numbers

$$0 + 1 = 1$$

$$1 + 1 = 2$$

$$1 + 2 = 3$$

$$2 + 3 = 5$$

$$3 + 5 = 8$$

$$5 + 8 = 13$$

$$8 + 13 = 21$$

$$\dots\dots\dots$$

Comparing the given series with Fibonacci series, the number '6' need to be changed with number '5' to make it a Fibonacci series.

Thus replacing '6' by '5' in the given series.

Hence, the correct option is (C).

1.111 (B)

Given : Sequence of numbers

$$\begin{array}{ccccccc} 6, & 9, & 14, & x, & 30, & 41 \\ \swarrow & \searrow & \swarrow & \searrow & \swarrow & \searrow \\ & +3 & +5 & +7 & +9 & +11 \end{array}$$

Here each number is obtained by adding consecutive odd number in the previous number.

$$\begin{aligned} \text{i.e., } 6 + 3 &= 9 \\ 9 + 5 &= 14 \\ 14 + 7 &= x \\ x + 9 &= 30 \\ 30 + 11 &= 41 \\ 41 + 13 &= 54 \dots\dots\dots \end{aligned}$$

Hence, $14 + 7 = x$

$$21 = x$$

Or

$$x + 9 = 30$$

$$x = 30 - 9$$

$$x = 21$$

Possible value of x is 21.

Hence, the correct options is (B).

1.112 (B)

Given : Five digits numbers 1, 3, 4, 6, 7

We want 4-digit positive integer and divisible by 3.

Case (i) : 1, 4, 6, 7

The sum of the above four digit numbers is 18 which is divisible by 3 and we can arrange in 4! ways.

$$4! = 4! = 24$$

Case (ii) : 1, 3, 6, 7

The Sum of the above four digit number is 17 which is not divisible by 3.

Case (iii) : 1, 3, 4, 7

The sum of the above four digit numbers is 15 which is divisible by 3 and we can arrange in 4! ways.

$$4! = 24$$

Case (iv) : 1, 3, 4, 6

The sum of the above four digits Numbers is 14, which is not divisible by 3.

So, the Total Number of four-digit Numbers divisible by 3 is

$$= 4! + 4! = 48$$

Hence the correct option is (B).

1.113 (B)

Given series,

$$\begin{aligned} 2 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{8} + \frac{1}{9} + \frac{1}{16} + \frac{1}{27} + \dots \infty \\ 2 + \left(\frac{1}{2} + \frac{1}{2^2} + \frac{1}{2^3} + \dots \infty \right) \\ + \left(\frac{1}{3} + \frac{1}{3^2} + \dots \infty \right) \end{aligned}$$

G.P. form,

Geometric progression (G.P) form

$$= a_1 + a_1 r + a_1 r^2 + \dots$$

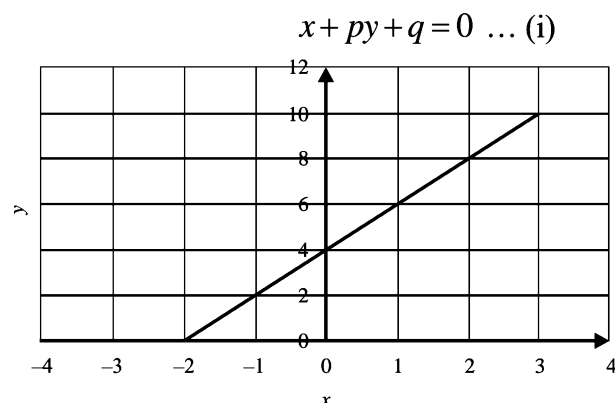
The sum of infinite G.P series is given by,

$$\begin{aligned} S &= \frac{a_1}{1-r} \quad (r < 1) \\ &= 2 + \left(\frac{1/2}{1-1/2} \right) + \left(\frac{1/3}{1-1/3} \right) \\ &= 2 + 1 + \frac{1}{2} = \frac{7}{2} \end{aligned}$$

Hence, the Correct option is (B).

1.114 (A)

Given : The Equation of a straight line



A linear equation in two variables can be rewritten in slope - intercept form

$$y = mx + c \quad \dots (ii)$$

From equation (i)

$$x + py + q = 0$$

$$py = -x - q$$

$$y = -\frac{x}{p} - \frac{q}{p} \quad \dots (iii)$$

From equation (ii) and (iii), we get

$$\text{Slope } (m) = -\frac{1}{p}$$

$$Y\text{-intercept } (c) = -\frac{p}{q}$$

From the Graph :

(i) The line passes through $(-2, 0)$ and $(0, 4)$

(ii) Y-intercept is 4, means when $x = 0$, $y = 4$

$$-\frac{q}{p} = 4$$

$$q = -4p \quad \dots \text{(iv)}$$

(iii) Slope $(m) = \frac{y_2 - y_1}{x_2 - x_1}$

$$(m) = \frac{4 - 0}{0 - (-2)} = 2$$

$$-\frac{1}{p} = 2$$

$$p = -\frac{1}{2} \quad \dots \text{(v)}$$

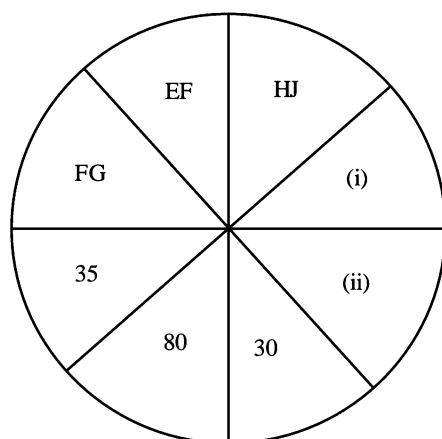
$$q = -4\left(-\frac{1}{2}\right) = 2$$

$$p = \frac{1}{2}, q = 2$$

Hence, the correct option is (A).

1.115 (C)

Given : In the given figure, EF and HJ are coded as 30 and 80 respectively. (Figure from question)



The given diagram follows a multiplication pattern checking the given values :

$$\bullet \quad EF = 5 \times 6 = 30$$

$$\bullet \quad HJ = 8 \times 10 = 80$$

$$\bullet \quad EG = 5 \times 7 = 35$$

Now from the options only $FG = 6 \times 7 = 42$ satisfies this logic.

Hence, the correct option is (B).

1.116 (B)

Given : P_1 and P_2 are two arbitrary prime numbers.

From option (A) : $(P_1 + P_2)$ is not a prime number.

Thus is false because the sum of two prime numbers can be prime.

From option (B) : $P_1 P_2$ is not a prime number.

This is false because the sum of two prime numbers can be prime.

Example : $2 + 3 = 5$ (Prime number)

From option (B) : $P_1 P_2$ is not a prime number.

This is always true because the product of two prime numbers is always composite.

From option (C) : $P_1 + P_2 + 1$ is a prime number.

Thus is not necessarily true for all prime numbers.

From option (D) : $P_1 P_2 + 1$ is a prime number.

This is also not necessarily true.

Example : $P_1 = 2, P_2 = 3$

$$= P_1 P_2 + 1 = 2 \times 3 + 1$$

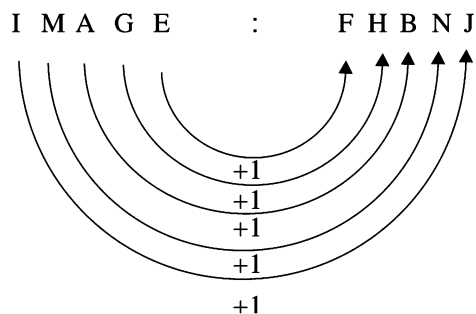
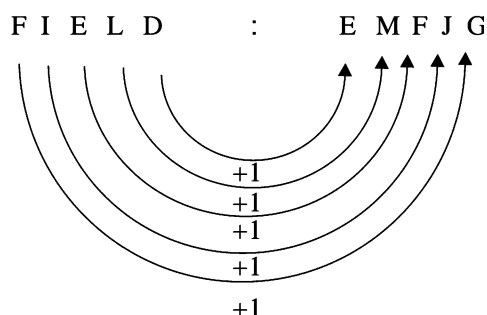
$$= 7 \text{ (Prime number)}$$

But for $P_1 = 3, P_2 = 5$

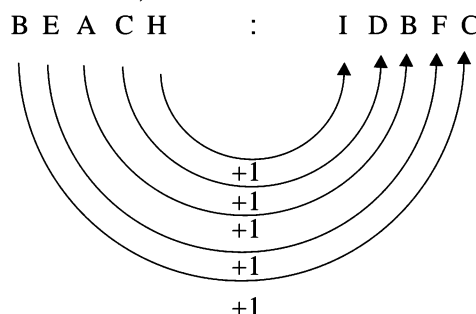
$$= P_1 P_2 + 1 = 3 \times 5 + 1$$

$$= 16 \text{ (which is not prime)}$$

Hence, the correct option is (B).

1.117 (B)**IMAGE is coded as FHBNJ****FIELD is coded as EMFJG**

From the above coding scheme BEACH is coded as shown below,



Hence, the correct option is (B).

1.118 (C)

Series expansion of e^x is,

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$$

Where $x = 1$

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \dots$$

$$\therefore \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \dots = e - 1$$

Hence, the correct option is (C).

1.119 (D)**Given :**

(i) HIDE $\rightarrow 19 - 23 - 7 - 11$

(ii) CAGE $\rightarrow 5 - 2 - 17 - 11$

Observing the pattern, it appears that letters are mapped to numerical values based on their position in the alphabet.

Now, encoding HIGH

- $H \rightarrow 19$
- $I \rightarrow 23$
- $G \rightarrow 17$
- $H \rightarrow 19$

Hence, the correct option is (D).

1.120 (D)

Given : $P^2 = Q^2 + 13$

$$[P^2 - Q^2 = 13]$$

$$(P - Q)(P + Q) = 13 = 1 \times 13$$

$$P - Q = 1$$

$$P + Q = 13$$

$$P = 7$$

$$Q = 6$$

and $P \times Q = 42$

Hence, the correct option is (D).

1.121 (A)

This exactly matches the graph.

Given :

$$H_K(S) = \max(S - K, 0)$$

$$H_{10}(S) = \max(S_{10}, 0) \text{ Start increasing after 10}$$

$$H_{20}(S) = \max(S_{20}, 0) \text{ Start increasing after 20}$$

$$\text{If we compute } H_{10}(S) - H_{20}(S) :$$

$$\text{Before 10} \rightarrow \text{Both 0} \rightarrow \text{Result} \rightarrow 0$$

$$\text{Between 10 and 20} \rightarrow \text{Equals } S_{10}$$

$$\text{After 20} \rightarrow \text{Equals } (S_{10}) - (S_{20}) = 10$$

Hence, the correct option is (A).

1.122 (B)**Factorize :**

$$70 = 2 \times 5 \times 7$$

Digits must be 2, 5, 7 (only valid one-digit factors).

Sum of digits :

$$2 + 5 + 7 = 14$$

Hence, the correct option is (B).

1.123 (C)

$$x = n^{\log_{10}(m)}$$

Take the $\log_{10}$ of both sides :

$$\log_{10}(x) = \log_{10}(n^{\log_{10}(m)})$$

Using the logarithm power rule ($\log(a^b) = b \cdot \log(a)$), bring the exponent down to the front :

$$\log_{10}(x) = \log_{10}(m) \cdot \log_{10}(n)$$

Step 2 : Solve for y

$$y = m^{\log_{10}(n)}$$

Take the $\log_{10}$ of both sides :

$$\log_{10}(y) = \log_{10}(m^{\log_{10}(n)})$$

Bring the exponent down to the front :

$$\log_{10}(y) = \log_{10}(n) \cdot \log_{10}(m)$$

- $\log_{10}(x) = \log_{10}(m) \cdot \log_{10}(n)$
- $\log_{10}(y) = \log_{10}(m) \cdot \log_{10}(n)$

Because $\log_{10}(x)$ equals $\log_{10}(y)$, it must be true that :

$$x = y$$

Hence, the correct option is (C).

1.25 (C)

PQ and RS are consecutive two-digit numbers

Digits P, Q, R, S, X, Y are all distinct

$$(PQ)^2 + (RS)^2 = XYP$$

Try consecutive numbers crossing a decade

$$PQ = 19, RS = 20$$

Compute

$$\begin{aligned} &19^2 + 20^2 \\ &= 361 + 400 \\ &= 761 \end{aligned}$$

Thus,

$$XYP = 761$$

So, $Y = 6$

All digits 1, 9, 2, 0, 7, 6 are distinct.

Hence, the correct option is (C).

Engineering Services Examination (ESE)**1. (D)**

Given : Writing in the form of x and y as present ages of Son and Father respectively.

Ten years ago,

$$\text{Age of Father (y)} = 12 \times \text{Age of Son (x)}$$

$$\text{i.e. } y - 10 = 12(x - 10)$$

$$y - 10 = 12x - 120$$

$$12x - y = 110 \quad \dots(i)$$

After 10 years,

$$\text{Age of Father (y)} = 2 \times \text{Age of Son (x)}$$

$$\text{i.e. } y + 10 = 2(x + 10)$$

$$y + 10 = 2x + 20$$

$$2x - y = -10 \quad \dots(ii)$$

From equation (i) and (ii),

$$(12x - y) - (2x - y) = 110 - (-10)$$

$$10x = 120$$

$$x = 12$$

Put the value of x in equation (ii).

Thus, $y = 34$ and Present ages of Father and Son 34 years and 12 years respectively.

Hence, the correct option is (D).

2. (C)**Given :**

Clock strikes once at 1 O'clock, twice at 2 O'clock, thrice at 3 O'clock and so on.

Therefore clock strike in 12 hours

$$= (1+2+3+4+5+6+7+8+9+10+11+12) \text{ times}$$

Since, sum of first n natural number

$$= \text{Number of total terms} \times \text{Average of total terms}$$

Here, Number of total terms = 12

$$\text{Since, average of first } n \text{ natural number} = \frac{n+1}{2}$$

$$\text{Average, } \frac{n+1}{2} = \frac{12+1}{2} = 6.5$$

$$\text{Sum of first 12 natural numbers} = 12 \times 6.5 = 78$$

$$\text{Thus, clock strikes in 24 hours} = 78 \times 2 = \mathbf{156}$$

Hence, the correct option is (C).

Key Point

Sum of first n natural number

$$= \text{Number of total terms} \times \text{Average of total terms}$$

3. (B)

Given : First term = 5, Last term = 100

Since, average of first n natural number

$$= \frac{\text{First term} + \text{Last term}}{2}$$

$$\text{Number of terms} = \frac{\text{Last term} - \text{First term}}{\text{Common difference}} + 1$$

$$= \frac{100-5}{5} + 1 = 20$$

Therefore, sum of all natural numbers between 1 and 101 which are divisible by 5

$$= 20 \times 52.5 = \mathbf{1050}$$

Hence, the correct option is (B).

4. (C)

$$\theta = \left| 30H - \frac{11}{2}M \right|$$

$$\theta = \left| 30 \times 3 - \frac{11}{2} \times 30 \right|$$

$$\theta = |90 - 165|$$

$$\theta = 75^\circ$$

Hence, the correct option is (C).

5. (B)

Sum of series

$$\begin{aligned} & 2^2 + 4^2 + 6^2 + \dots + 20^2 \\ &= (2)^2 [1^2 + 2^2 + 3^2 + \dots + 10^2] \\ &= 4 \left[\frac{10(10+1)(20+1)}{6} \right] \\ &= \frac{4 \times 10 \times 11 \times 21}{6} = 1540 \end{aligned}$$

Hence, the correct option is (B).

6. (D)

Given : 21 mango trees 42 apple trees and 56 orange trees.

$$\text{Total trees} = 21 + 42 + 56 = 119$$

$$\text{HCF}(21, 42, 56) = 7$$

$$\text{Trees in one row} = 7$$

$$(7 + 7 + 7 + \dots + n) = 119$$

$$7n = 119$$

$$n = 17$$

Hence the correct option is (D).

7. (A)

Given : There are a total of 36562 army men.

As we know that

$$(19)^2 = 36481$$

$$\text{Soldiers Left} = 36562 - 36481 = 81$$

Hence the correct option is (A).

8. (B)

$$\begin{array}{ccccccccc} \text{I} & & \text{L} & \text{O} & \text{V} & \text{E} & & \text{Y} & \text{O} & \text{U} \\ 9 & & 12 & 15 & 22 & 5 & & 25 & 15 & 21 \end{array}$$

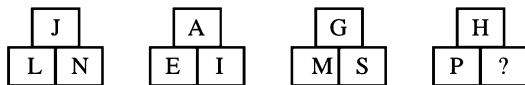
$$= 124 = 1 + 2 + 4 = 7$$

G O T O
7 15 20 15

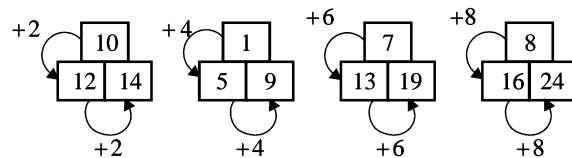
H E L L
8 5 12 12
= 94 = 9 + 4
= 13 = 1 + 3
= 4

Hence, the correct option is (B).

9. (C)



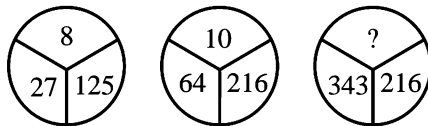
Replace above all alphabets with their Numbers.



∴ (24 = X)

Hence, the correct option is (C).

10. (B)



27 125 3 ³ 5 ³	64 216 4 ³ 6 ³	343 216 7 ³ 6 ³
3 + 5 = 8	4 + 6 = 10	7 + 6 = 13

Hence, the correct option is (B).

11. (B)

As 3504

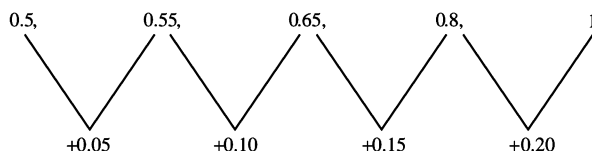
R → First four digits

$$3504 = 3 + 5 + 0 + 4 = 12$$

Hence, the correct option is (B).

12. (D)

Given : 0.5, 0.55, 0.65, 0.8, ?



Hence, the correct option is (D).

13. (A)

Let us Assume the Number to be x .

According to the question,

$$\frac{(2x)^2}{3} - 30 = 18$$

$$4x^2 - 90 = 54$$

$$4x^2 = 144$$

$$x^2 = \left(\frac{144}{4}\right) = 36$$

$$x = 6 \text{ (or) } -6$$

Hence the correct option is (A).

14. (A)

Take Any Number either 64 or 86

(Less then 100 and more than 50)

$$64 + 83 = 147$$

$$1 + 47 = 48$$

$$(64 - 48) = 16$$

OR

$$86 + 83 = 169$$

$$1 + 69 = 70$$

$$86 - 70 = 16$$

Hence the correct option is (A).

15. (B)

We know that, the required number would be such that it leaves a remainder of 1. When divided by 3, 4, 5 or 6 and no remainder when divided by 7.

$$\text{LCM of } (3, 4, 5, 6) = 60$$

So, number in the form = $60x + 1$

Now consider the value of x to form a number so that it leaves a remainder of 1. When divided by 3, 4, 5 or 6 and no remainder when divided by 7.

$$\text{Number} = ((60 \times 5) + 1) = 301$$

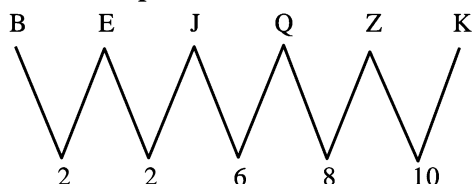
∴ 301 is divisible by 7.

Hence, the correct option is (B).

16. (B)

We are told that letters are skipped in an increasing order: 2, 4, 6, 8 ... That is :

- Start from a letter
- Skip 2 letters to get the next
- Then skip 4 to get the next
- Then skip 6, and so on



Hence, the correct option is (B).

17. (B)

Cementation involves joining ceramic raw materials using a binder that hardens at room temperature without requiring firing or sintering.

Hence, the correct option is (B).

18. (A)

Plastic consists of long chain polymer molecules that are randomly oriented. This random orientation gives plastics their flexibility and insulating property.

Hence, the correct option is (A).

19. (A)

It refers to systems like firewalls that regulate traffic between a trusted network and an untrusted network. These systems enforce access control policies at the network boundary. Intrusion monitoring means detecting unauthorized activity. It is not about controlling access.

Hence, the correct option is (A).

20. (D)

For each of the four directions around the center 8, the sum of the three numbers is the same.

Top vertical :

$$7 + 4 + 1 = 12$$

Left horizontal :

$$8 + 1 + 3 = 12$$

Right horizontal :

$$5 + 2 + 5 = 12$$

So the bottom vertical must also sum to 12 :

$$7 + ? + 3 = 12$$

$$? = 12 - 10 = 2$$

Hence, the missing number is

2

Hence, the correct option is (D)

21. (B)

The staircase-type arrangement forms a square split diagonally. It is the standard visual proof of:

$$1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$$

Hence, the correct option is (B).



2

Average, Percentage & Ratio

A. PERCENTAGE :

The terms percent means “for every hundred”. A fraction whose denominator is 100 is called percentage and the numerator of the fraction is called the rate percent.

1. Percentage and Fraction Equivalents :

Some fraction equivalent of percentage are given below,

$\frac{1}{1} = 100\%$	$\frac{1}{2} = 50\%$	$\frac{1}{3} = 33.33\%$	$\frac{1}{4} = 25\%$
$\frac{1}{5} = 20\%$	$\frac{1}{6} = 16.67\%$	$\frac{1}{7} = 14.28\%$	$\frac{1}{8} = 12.5\%$
$\frac{1}{9} = 11.11\%$	$\frac{1}{10} = 10\%$	$\frac{1}{11} = 9.09\%$	$\frac{1}{12} = 8.33\%$
$\frac{1}{13} = 7.69\%$	$\frac{1}{14} = 7.14\%$	$\frac{1}{15} = 6.66\%$	$\frac{1}{16} = 6.25\%$
$\frac{1}{17} = 5.88\%$	$\frac{1}{18} = 5.55\%$	$\frac{1}{19} = 5.29\%$	$\frac{1}{20} = 5.00\%$

2. Successive Percentage change :

The population of a state increases by 10 % in one year and again increases by 10 % in the next year, then what is the net increase in the population in two years.

Let the initial population be P .

After 1st year population,

$$P_1 = \left(1 + \frac{10}{100}\right)P = \frac{11}{10}P$$

After 2nd year population,

$$P_2 = \left(1 + \frac{10}{100}\right)\frac{11}{10}P = \frac{121}{100}P = \left(1 + \frac{21}{100}\right)P$$

Therefore population increases by 21% of the original population.

3. Formulae

$$(i) \text{ Increase in \%} = \frac{\text{Increase}}{\text{Original Value}} \times 100$$

$$(ii) \text{ Decrease in \%} = \frac{\text{Decrease}}{\text{Original Value}} \times 100$$

$$(iii) \text{ Change in \%} = \frac{\text{Change}}{\text{Original Value}} \times 100$$

$$(iv) \text{ Average percentage rate of change over a period} \\ = \frac{(\text{New Value} - \text{Old value})}{\text{Old Value}} \times \frac{100}{n} \% ; \quad \text{where } n = \text{period}$$

(v) If there is successive increase of $x\%$ and $y\%$ then,

$$\text{Net change} = x + y + \frac{xy}{100} \%$$

(vi) If there is successive discount of $x\%$ and $y\%$ then,

$$\text{Total discount} = x + y - \frac{xy}{100} \%$$

(vii) If A's income is $X\%$ more than that of B, then B's income is $\frac{X\%}{100 + X\%} \times 100$ less than that of A.

(viii) If A's income is $X\%$ less than that of B, then B's income is $\frac{X\%}{100 - X\%} \times 100$ more than that of A.

(ix) If the price of a commodity increases by $X\%$, then reduction in consumption, so as not to increased expenditure is $\frac{100X}{100 + X} \%$.

(x) If the price of a commodity decreases by $X\%$, then increases in consumption, so as not to decreases expenditure, is $\frac{100X}{100 - X} \%$.

B. PROFIT AND LOSS :

Cost Price : It is the price at which seller obtains a product.

Selling Price : It is the price at which seller sells a product.

Profit / Loss : This is the difference between selling price and cost price. If the difference is positive, it is known as profit and if the difference is negative then it is known as loss.

Formulae :

$$1. \text{ Profit or Gain} = (\text{SP} - \text{CP}) \%$$

$$2. \text{ Loss} = \text{CP} - \text{SP}$$

3. $\text{Gain \%} = \frac{\text{Gain}}{\text{CP}} \times 100\%$
4. $\text{Loss \%} = \frac{\text{Loss}}{\text{CP}} \times 100\%$
5. $\text{SP} = \text{CP} \times \frac{100 + \text{Gain \%}}{100} = \text{CP} \times \frac{100 - \text{Loss \%}}{100}$
6. $\text{CP} = \text{SP} \times \frac{100}{100 + \text{Gain \%}} = \text{SP} \times \frac{100}{100 - \text{Loss \%}}$
7. If the period of investment is the same for each partner, then the profit or loss is divided in the ratio of their investments.
8. If X and Y are partners in a Business, then
 - (i) $\frac{\text{Investment of X}}{\text{Investment of Y}} = \frac{\text{Profit of X}}{\text{Profit of Y}}$
 Or $\frac{\text{Investment of X}}{\text{Investment of Y}} = \frac{\text{Loss of X}}{\text{Loss of Y}}$
 - (ii) $\frac{\text{Investment of X} \times \text{Period of Investment of X}}{\text{Investment of Y} \times \text{Period of Investment of Y}} = \frac{\text{Profit of X}}{\text{Profit of Y}} \times \frac{\text{Loss of X}}{\text{Loss of Y}}$

C. AVERAGE :

Average is defined as the ratio of sum of the quantities to the number of quantities.

$$\text{Average} = \frac{\text{Sum of all quantities}}{\text{No. of quantities}}$$

$$A = \frac{X_1 + X_2 + X_3 + \dots + X_n}{N}$$

Weighted Mean :

Let us assume we have to calculate the combined average marks of two sections of class 12 provided students of section A have 60% average marks and students of section B have 70% average marks. Now, the normal answer given by any one will be 65% which is wrong because we can not decide the combine average marks of both the sections without knowing the number of students in each section. That is how we calculate weighted mean.

Important Points :

1. If each number is increased / decreased by a quantity n , then the mean also increases or decreases by the same quantity.
2. If each number is multiplied / divided by a quantity n , then the mean is also multiplied or divided by the same quantity.
3. If the same value is added to half of the quantities and same value is subtracted from other half quantities then there will not be any change in the final value of the average.

D. RATIO AND PROPORTION :**1. Ratio :**

Ratio is the relation which one quantity bears to another of the same kind in magnitude provided both quantities are of same kind. Now, in two quantities a and b the fraction $\frac{a}{b}$ is called the ratio of a to b . It is usually expressed as $a : b$, a and b are said to be the terms of the ratio. The former (numerator) ' a ' is called the Antecedent of the ratio and latter (denominator) ' b ' is called consequent.

Composition of Ratio :

(i) **Compounded Ratio :** Ratio obtained by multiplication of two or more ratios is called compounded ratio. Compounded ratio is given by,

$$\frac{a}{b} \times \frac{c}{d} \times \frac{e}{f} = \frac{ace}{bdf}$$

(ii) **Reciprocal Ratio :** For any ratio $a : b$, the reciprocal ratio will be $\frac{1}{a}, \frac{1}{b}$.

The application of it is in calculating the ratio of the wages distributed among the workers, which is equal to the reciprocal ratio of number of days taken by them to complete the work.

2. Proportion :

When two ratios are equal, the four terms involved, taken in order are called proportional, and they are said to be in proportion. If $a : b :: c : d$ then we have $ad = bc$ i.e. the terms a and d are called Extremes and the terms b and c are called the Means. The term a, b, c and d are known by the name 1st, 2nd, 3rd and the 4th proportion respectively.

Basics of Proportion :

(i) Let us take four quantities a, b, c and d such that they are in proportion i.e. $a : b : c : d$ then,

$$\frac{a+b}{a-b} = \frac{c+d}{c-d}$$

This operation is called componendo and Dividendo.

(ii) If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f}$ then

$$\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \frac{a+c+e}{b+d+f} = \frac{a+c-e}{b+d-f} = \frac{k_1a+k_2c+k_3e}{k_1b+k_2d+k_3f}$$

Types of Proportion :

(i) **Continued Proportion :** Three quantities are said to be in continued proportion if the ratio of the first to the second is same as the ratio of the second to the third.

Thus a, b and c are in continued proportion if $a : b : c$ i.e. $\frac{a}{b} = \frac{b}{c}$

(ii) **Mean Proportion** : If a, b, c are in continued proportion then second quantity ' b ' is called the mean proportional between ' a ' and ' c ' and a, b and c are known as 1st, 2nd and 3rd proportion respectively.

$$\frac{a}{b} = \frac{b}{c} \text{ then } b^2 = ac$$

$$\text{Or } b = \sqrt{ac}$$

(iii) **Direct Proportion** : If A is directly proportional to B , then if A increases, B will also increase i.e. the proportional change occurs in the same direction. When A is directly proportional to B then,

$$\frac{A}{B} = \text{Constant} \text{ or } \frac{A_1}{B_1} = \frac{A_2}{B_2}$$

(iv) **Indirect / Inverse proportion** : If A is in indirect proportion to B then if A increases, B decreases proportionally i.e. the proportional change occurs in the opposite direction.

If A is in inverse proportion to B then,

$$A \propto \frac{1}{B} \Rightarrow AB = \text{Constant}$$

E. INTEREST :

1. Simple Interest

The amount of money calculated with reference to principle amount for a particular period at a certain rate of interest, is known as simple interest.

$$SI = \frac{P \times R \times T}{100}$$

Where, P = principal amount

R = % rate of interest

T = time duration (in years)

2. Compound Interest

The interest of the previous years are added to the principal for the calculation of the compound interest.

$$CI = P \left[1 + \frac{R}{100} \right]^T - P$$

Where, P = principal amount

R = rate of interest

T = time duration

(i) When interest is compounded annually then amount A will be

$$A = P \left[1 + \frac{R}{100} \right]^T$$

(ii) When interest is compounded half yearly then

$$A = \left[1 + \frac{R/2}{100} \right]^{2T}$$

(iii) When interest is compounded quarterly

$$A = \left[1 + \frac{R/4}{100} \right]^{4T}$$

(iv) When differential rate of interest is changed i.e. if rate of interest is $R_1\%$ for first year, $R_2\%$ for second year and $R_3\%$ for third year and so on then,

$$\text{Amount} = P \left[1 + \frac{R_1}{100} \right] \times \left[1 + \frac{R_2}{100} \right] \times \left[1 + \frac{R_3}{100} \right] \dots$$

Example 1

The average score of a cricket player after 25 innings is 25 and in the 25th innings the player scores 25 runs. In the 26th innings what minimum number of runs will be required to increase his average score by 2 than it was before the 26th innings?

Solution :

Given : Average score of a cricket player after 25 innings is 25.

The average score of a cricket player after 25th innings = $(25 + 25 + \dots + 25) / 25 = 25$

Let required run = X

According to given condition,

$$(625 + X) / 26 = 27 \quad \text{(average increases by 2)}$$

$$X = 26 \times 27 - 625 = 77$$

Hence, the required run is 77.

Example 2

The average weight of a group of 20 boys was calculated to be 89.4 kg and it was later discovered that one weight was misread as 78 kg instead of the correct one of 87 kg. The correct average weight is

Solution :

Given : Average weight of a group of 20 boys was calculated to be 89.4 kg

According to given condition,

$$\text{Total actual weight} = (89.4 \times 20 - 78 + 87) \text{ kg} = 1797 \text{ kg}$$

$$\text{Hence, correct average weight} = 1797 / 20 = 89.85 \text{ kg}$$

Example 3

In a zoo, the zoo authority announces 40% discount on every ticket which costs 50 paise in order to attract more visitors. For this reason, sale off ticket increases by 50%. Find the percentage increase in the number of visitors.

Solution :

Let the number of visitors be 100.

Total revenue = $0.50 \times 100 = \text{Rs. } 50$

New price = $0.50 \times (60/100) = 30 \text{ paise}$

New revenue = $50 \times (150/100) = \text{Rs. } 75$

Number of visitors = $75 / 0.30 = 250$

So, % change in number = $[(250 - 100) / 100] \times 100 = 150\%$

Hence, the percentage increase in the number of visitors is 150%.

Example 4

A man sold an article for Rs. 6800 and incurred a loss. Had he sold the article for Rs. 7850, his gain would have been equal to half of the amount of loss that he incurred. At what price should he sell the article to have 20% profit?

Solution :

Given : Man sold an article for Rs. 6800

Let the cost price be x .

Then, Loss = $(x - 6800)$

Again, Profit = $(7850 - x)$

According to the given condition,

$$(7850 - x) = (x - 6800) / 2$$

$$15700 - 2x = x - 6800$$

$$3x = 15700 + 6800 = 22500$$

$$x = 22500 / 3 = 7500$$

So, the selling price = $(7500 \times 120) / 100 = \text{Rs. } 9000$

Hence, the selling price is Rs. 9000.

Example 5

A bought a certain quantity of bananas at a total cost of Rs. 1500. He sold 1/3 of these bananas at 25% loss. If he earns an overall profit of 10%, at what percentage profit did A sell the rest of the bananas?

Solution :

Given : Cost of price Rs. 1500

Total CP = 1500

Total SP = $1500 + 10\% \text{ of } 1500 = 1500 + 150 = 1650$

CP of 1/3 of bananas = $1500 / 3 = \text{Rs. } 500$

SP of 1/3 of bananas at 25% loss = $500 - [(500 \times 25) / 100] = 500 - 125 = 375$

SP of the rest of bananas = $1650 - 375 = 1275$

Now, CP of the rest of bananas = $1500 - 500 = 1000$

Profit on the rest of bananas = $1275 - 1000 = 275$

% of profit on the rest of bananas = $(275 / 1000) \times 100 = 27.5\%$

Hence, the percentage profit did A sell the rest of the bananas is 27.5%.

2010 IIT Guwahati**2.1**

A person invests Rs.1000 at 10% annual compound interest for 2 years. At the end of two years the whole amount is invested at an annual simple interest of 12% for 5 years. The total value of the investment finally is : [MN]

- (A) 1776 (B) 1760
(C) 1920 (D) 1936

2011 IIT Madras**2.2**

There are two candidates P and Q in an election. During the campaign, 40% of the voters promised to vote for P , and rest for Q . However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q . 25% of the voters went back on their promise to vote for Q and instead voted for P . Suppose, P lost by 2 votes, then what was the total number of voters

[AG, CY, EC, EE, IN, MA, MT, XE, XL]

- (A) 100 (B) 110
(C) 90 (D) 95

2012 IIT Delhi**2.3**

The data given in the following table summarizes the monthly budget of an average household.

Category	Amount (Rs.)
Food	4000
Clothing	1200
Rent	2000
Savings	1500
Other expenses	1800

The approximate percentage of the monthly budget **NOT** spent on savings is [CY, EC, EE, IN, MA, MT, XE, XL]

- (A) 10% (B) 14%
(C) 81% (D) 86%

2.4

The total runs scored by four cricketers P , Q , R , and S in years 2009 and 2010 are given in the following table :

Player	2009	2010
P	802	1008
Q	765	912
R	429	619
S	501	701

The player with the lowest percentage increase in total runs is [AE, AG, MN]

- (A) P (B) Q
(C) R (D) S

2013 IIT Bombay**2.5**

Following table provided figures (in rupees) on annual expenditure of a firm for two years 2010 and 2011.

Category	2010	2011
Raw material	5200	6240
Power and fuel	7000	9450
Salary and wages	9000	12600
Plant and machinery	20000	25000
Advertising	15000	19500
Research and development	22000	26400

In 2011, which of the following two categories have registered by same percentage?

[AR, CE, GG, MA, MT, PH, TF]

- (A) Raw material and Salary & wages
(B) Salary & wages and Advertising
(C) Power & fuel and Advertising
(D) Raw material and research and development

- 2.6 ✗ A firm is selling its product at Rs. 60 per unit. The total cost of production is Rs. 100 and firm is earning total profit of Rs. 500. Later, the total cost increased by 30%. By what percentage the price should be increased to maintain the same profit level.

[AR, CE, GG, MA, MT, PH, TF]

- (A) 5 (B) 10
(C) 15 (D) 30

2014 IIT Kharagpur

- 2.7 ✗ Industrial consumption of power doubled from 2000-2001 to 2010-2011. Find the annual rate of increase in percent, assuming it to be uniform over the years.

[EC-4, ME-4]

- (A) 5.6 (B) 7.2
(C) 10.0 (D) 12.2

- 2.8 ✓ Round-trip tickets to a tourist destination are eligible for a discount of 10% on the total fare. In addition, groups of 4 or more get a discount of 5% on the total fare. If the one way single person fare is Rs 100, a group of 5 tourists purchasing round trip tickets will be charged Rs. _____.

[CS-1, EE-1]

- 2.9 In a survey, 300 respondents were asked whether they own a vehicle or not. If yes, they were further asked to mention whether they own a car or scooter or both. Their responses are tabulated below. What percent of respondents do not own a scooter? [CS-1, EE-1]

		Men	Women
Own vehicle	Car	40	34
	Scooter	30	20
	Both	60	46
Do not own vehicle		20	50

- 2.10 The table below has question-wise data on the performance of students in an examination. The marks for each

question are also listed. There is no negative or partial marking in the examination.

Q. No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1.	2	21	17	6
2	3	15	27	2
3	2	23	18	3

What is the average of the marks obtained by the class in the examination?

[CS-3, EE-3]

- (A) 1.34 (B) 1.74
(C) 3.02 (D) 3.91

- 2.11 The Gross Domestic Product (GDP) in Rupees grew at 7% during 2012-2013. For international comparison, the GDP is compared in US Dollars (USD) after conversion based on the market exchange rate. During the period 2012-2013 the exchange rate for the USD increased from Rs. 50/USD to Rs. 60/USD. India's GDP in USD during the period 2012-2013 [CS-3, EE-3]

- (A) Increased by 5%
(B) Decreased by 13%
(C) Decreased by 20%
(D) Decreased by 11%

- 2.12 The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

- (A) 3-4 years (B) 4-5 years
(C) 5-6 years (D) 6-7 years

- 2.13 A foundry has a fixed daily cost of Rs 50,000 whenever it operates and a variable cost of Rs 800Q, where Q is the daily production in tonnes. What is the cost of production in Rs per tonne for a daily production of 100 tonnes?

[AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

- 2.14** One percent of the people of country X are taller than 6 ft. Two percent of the people of country Y are taller than 6 ft. There are thrice as many people in country X as in country Y. Taking both countries together, what is the percentage of people taller than 6 ft?

[AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

- (A) 3.0 (B) 2.5
(C) 1.5 (D) 1.2

2015 IIT Kanpur

- 2.15** A cube of side 3 units is formed using a set of smaller cubes of side 1 unit. Find the proportion of the number of faces of the smaller cubes visible to those which are NOT visible.

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]

- (A) 1 : 4 (B) 1 : 3
(C) 1 : 2 (D) 2 : 3

- 2.16** From a circular sheet of paper of radius 30 cm, a sector of 10% area is removed. If the remaining part is used to make a conical surface, then the ratio of the radius and height of the cone is _____.

[EC-3, ME-2]

- 2.17** The number of students in a class who have answered correctly, wrongly, or not attempted each question in an exam, are listed in the table below. The marks for each question are also listed. There is no negative or partial marking.

Q. No.	Marks	Answered Correctly	Answered Wrongly	Not attempted
1	2	21	17	6
2	3	15	27	2
3	1	11	29	4
4	2	23	18	3
5	5	31	12	1

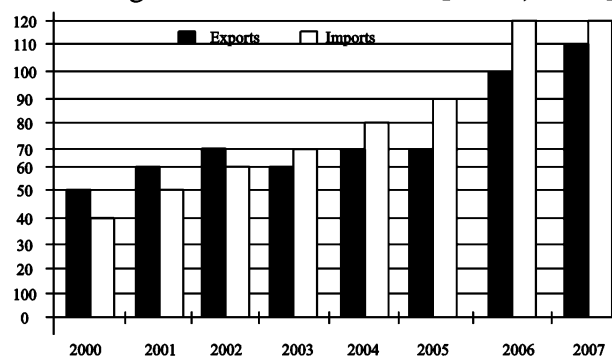
What is the average of the marks obtained by the class in the examination?

[CS-1, EE-1]

- (A) 2.290 (B) 2.970
(C) 6.795 (D) 8.795

- 2.18** The exports and imports (in crores of Rs.) of a country from the year 2000 to 2007 are given in the following bar chart. In which year is the combined percentage increase in imports and exports the highest?

[CE-1, CS-3]



- 2.19** Read the following table giving sales data of five types of batteries for years 2006 to 2012

Year	Type I	Type II	Type III	Type IV	Type V
2006	75	144	114	102	108
2007	90	126	102	84	126
2008	96	114	75	105	135
2009	105	90	150	90	75
2010	90	75	135	75	90
2011	105	60	165	45	120
2012	115	85	160	100	145

Out of the following, which type of battery achieved growth between the years 2006 and 2012?

[CE-2]

- (A) Type V (B) Type III
(C) Type II (D) Type I

2016 IISc Bangalore

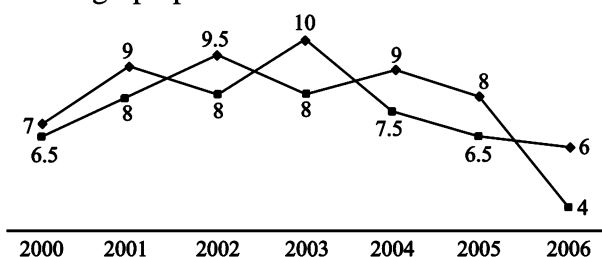
- 2.20** $(x\% \text{ of } y) + (y\% \text{ of } x)$ is equivalent to _____

[AG, CE-2, EY, MT, PI]

(A) 2% of xy (B) 2% of $\left(\frac{xy}{100}\right)$

(C) xy % of 100 (D) 100% of xy

- 2.21** Two finance companies, P and Q , declared fixed annual rates of interest on the amounts invested with them. The rates of interest offered by these companies may differ from year to year. Year-wise annual rates of interest offered by these companies are shown by the line graph provided below.



If the amounts invested in the companies, P and Q , in 2006 are in the ratio 8 : 9, then the amount s received after one year as interests from companies P and Q would be in the ratio :

[AG, CE-2, EY, MT, PI]

- (A) 2 : 3 (B) 3 : 4
(C) 6 : 7 (D) 4 : 3

2017 IIT Roorkee

- 2.22** In the summer, water consumption is known to decrease overall by 25%. A Water Board official states that in the summer household consumption decreases by 20%, while other consumption increases by 70%.

Which of the following statements is correct? [BT, CY, EC-1, EY, PI]

- (A) The ratio of household to other consumption is 8/17.
(B) The ratio of household to other consumption is 1/17.

(C) The ratio of household to other consumption is 17/8.

(D) There are errors in the official's statement.

- 2.23** If the radius of a right circular cone is increased by 50% its volume increases by

[CE-1, CH, MN]

- (A) 75% (B) 100%
(C) 125% (D) 237.5%

2018 IIT Guwahati

- 2.24** Two alloys A and B contain gold and copper in the ratios of 2:3 and 3:7 by mass, respectively. Equal masses of alloys A and B are melted to make an alloy C . The ratio of gold to copper in alloy C is,

[EC]

- (A) 5 : 10 (B) 7 : 13
(C) 6 : 11 (D) 9 : 13

- 2.25** Leila aspires to buy a car worth Rs. 10,00,000 after 5 years. What is the minimum amount in Rupees that she should deposit now in a bank which offers 10% annual rate of interest, if the interest was compounded annually?

[EC]

- (A) 5,00,000 (B) 6,21,000
(C) 6,66,667 (D) 7,50,000

- 2.26** A designer uses marbles of four different colours for his designs. The cost of each marble is the same, irrespective of the colour. The table below shows the percentage of marbles of each colour used in the current design. The cost of each marble increased by 25%. Therefore, the designer decided to reduce equal numbers of marbles of each colour to keep the total cost unchanged. What is the percentage of blue marbles in the new design? [EE]

Blue	Black	Red	Yellow
40%	25%	20%	15%

- (A) 35.75 (B) 40.25
(C) 43.75 (D) 46.25
- 2.27** A fruit seller sold a basket of fruits at 12.5% loss. Had he sold it for Rs.108 more, he would have made a 10% gain. What is the loss in Rupees incurred by the fruit seller? [CE-1]
(A) 48 (B) 52
(C) 60 (D) 108
- 2.28** The price of a wire made of a super alloy material is proportional to the square of its length. The price of 10 m length of wire is Rs. 1600. What would be the total price (in Rs.) of two wires of lengths 4 m and 6 m? [CE-1]
(A) 768 (B) 832
(C) 1440 (D) 1600
- 2.29** In a party, 60% of the invited guests are male and 40% are female. If 80% of the invited guests attended the party and if all the invited female guests attended, what would be the ratio of males to females among the attendees in the party? [CS, MN]
(A) 2 : 3 (B) 1 : 1
(C) 3 : 2 (D) 2 : 1

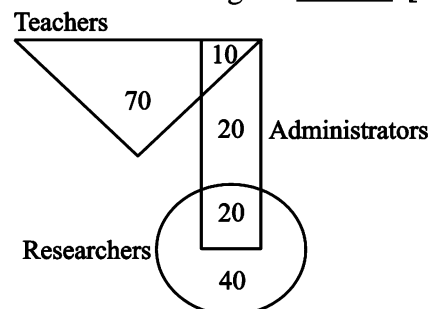
2019 IIT Madras

- 2.30** Population of state X increased by $x\%$ and the population of state Y increased by $y\%$ from 2001 to 2011. Assume that x is greater than y . Let P be the ratio of the population of state X to state Y in a given year. The percentage increase in P from 2001 to 2011 is _____. [CE-2]
(A) $\frac{x}{y}$ (B) $\frac{100(x-y)}{100+y}$

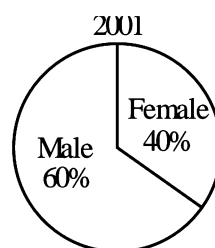
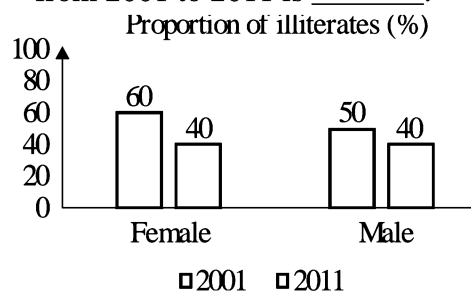
(C) $x - y$

(D) $\frac{100(x-y)}{100+y}$

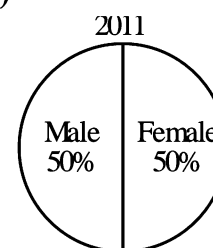
- 2.31** In the given diagram, teachers are represented in the triangle, researchers in the circle and administrators in the rectangle. Out of the total number of the people, the percentage of administrators shall be in the range of _____. [CH, CS]



- (A) 0 to 15 (B) 16 to 30
(C) 31 to 45 (D) 46 to 60
- 2.32** The bar graph in Panel (a) shows the proportion of male and female illiterates in 2001 and 2011. The proportions of males and females in 2001 and 2011 are given in Panel (b) and (c), respectively. The total population did not change during this period. The percentage increase in the total number of literates from 2001 to 2011 is _____. [EC]



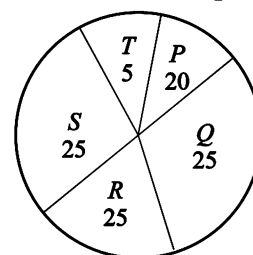
Panel (b)



Panel (c)

- (A) 35.43 (B) 33.43
(C) 30.43 (D) 34.43
- 2.33** The ratio of the number of boys and girls who participated in an examination is 4 : 3. The total percentage of candidates who passed the examination is 80 and the percentage of girls who passed is 90. The percentage of boys who passed is _____. [EE]
(A) 90.00 (B) 80.50
(C) 55.50 (D) 72.50
- 2.34** The radius as well as the height of a circular cone increases by 10%. The percentage increase in its volume is _____.
[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]
(A) 17.1 (B) 21.0
(C) 33.1 (D) 72.8
- 2.35** In a country of 1400 million population, 70% own mobile phones. Among the mobile phone owners, only 294 million access the Internet. Among these Internet users, only half buy goods from e-commerce portals. What is the percentage of these buyers in the country?
[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]
(A) 10.50 (B) 14.70
(C) 15.00 (D) 50.00
- 2.36** A person divided an amount of Rs. 100,000 into two parts and invested in two different schemes. In one he got 10% profit and in the other he got 12%. If the profit percentages are interchanged with these investments he would have got Rs. 120 less. Find the ratio between his investments in the two schemes.
[CY, ME-1, MN]
(A) 11 : 14 (B) 47 : 53
(C) 37 : 63 (D) 9 : 16

- 2.37** A firm hires employees at five different skill levels P, Q, R, S, T . The shares of employment at these skill levels of total employment in 2010 is given in the pie chart as shown. There were a total of 600 employees in 2010 and the total employment increased by 15% from 2010 to 2016. The total employment at skill levels P, Q and R remained unchanged during this period. If the employment at skill level S increased by 40% from 2010 to 2016 how many employees were there at skill level T in 2016? [CY, ME-1, MN]



- ✓ (A) 30 (B) 72
(C) 60 (D) 35
- 2.38** Mola is a digital platform for taxis in a city. It offers three types of rides – Pool, Mini and Prime. The table below presents the number of rides for the past four months. The platform earns one US dollar per ride. What is the percentage share of revenue contributed by Prime to the total revenues of Mola, for the entire duration? [ME-2, TF, XE, XL]

Type	Months			
	Jan	Feb	Mar	Apr
Pool	170	320	215	190
Mini	110	220	180	70
Prime	75	180	120	90

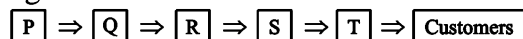
- (A) 16.24 (B) 23.97
(C) 38.74 (D) 25.86
- 2.39** Fiscal deficit was 4% of GDP in 2015 and that increased to 5% in 2016. If the

GDP increased by 10% from 2015 to 2016. The percentage increase in actual Fiscal deficit is [ME-2, TF, XE, XL]

- (A) 37.50 (B) 35.70
(C) 25 (D) 10

2020 IIT Delhi

- 2.40 There are five levels {P, Q, R, S, T} in a linear supply chain before a product reaches customers, as shown in the figure.



At each of the five levels, the price of the product is increased by 25%. If the product is produced at level P at the cost of Rs.120 per unit, what is the price paid (in rupees) by the customers?

[CY, ME-2, PI]

- (A) 187.50 (B) 366.21
(C) 234.38 (D) 292.96

2021 IIT Bombay

- 2.41 The current population of a city is 11,02,500. If it has been increasing at the rate of 5% per annum, what was its population 2 years ago?

[EC, ES, PE, PI, ST]

- (A) 9,92,500 (B) 9,95,006
(C) 10,00,000 (D) 12,51,506

- 2.42 In a company, 35% of the employees drink coffee, 40% of the employees drink tea and 10% of the employees drink both tea and coffee. What % of employees drink neither tea nor coffee?

[CE-1, CY, IN]

- (A) 25 (B) 35
(C) 40 (D) 15

- 2.43 The number of hens, ducks and goats in farm P are 65, 91 and 169, respectively. The total number of hens, ducks and goats in a nearby farm Q is 416. The ratio of hens : ducks : goats in farm Q is 5:14:13. All the hens, ducks and goats are sent from farm Q to farm P.

The new ratio of hens : ducks : goats in farm P is _____ [ME-1, XH]

- (A) 5:14:13 (B) 10:21:26
(C) 5:7:13 (D) 21:10:26

- 2.44 The ratio of boys to girls in class is 7 to 3. Among the options below, an acceptable value for the total number of students in the class is

[BT, CH, CS-1, MA, TF]

- (A) 21 (B) 73
(C) 37 (D) 50

2.45

Items	Cost (₹)	Profit (%)	Marked Price (₹)
P	5400	-	5860
Q	-	25	10000

Details of prices of two items P and Q are presented in the above table. The ratio of cost of item P to cost of item Q is 3 : 4. Discount is calculated as the difference between marked price and selling price. The profit percentage is calculated as the ratio of difference between selling price and cost price, to the cost price.

$$\text{Profit \%} = \frac{\text{Selling Price} - \text{Cost Price}}{\text{Cost Price}} \times 100$$

The discount on item Q, as a % of its marked price, is _____.

[BT, CH, CS-1, MA, TF]

- (A) 25 (B) 12.5
(C) 10 (D) 5

- 2.46 The number of students in three classes is in the ratio 3 : 13 : 6. If 18 students are added to each class, the ratio changes to 15 : 35 : 21.

The total number of students in all the three classes in the beginning was

[CS-2, XE, XL]

- (A) 110 (B) 66
(C) 22 (D) 88

2022 IIT Kharagpur

- 2.47 If $p:q=1:2$, $q:r=4:3$, $r:s=4:5$ and u is 50% more than s , what is the ratio $p:u=?$

[CE-1]

- (A) 2 : 15 (B) 16 : 45
(C) 1 : 5 (D) 4 : 25
- 2.48** P invested Rs. 5000 per month for 6 months of a year and Q invested x per month for 8 month of the year in a partnership business. The profit is shared in proportion to the total investment made in that year. If at the end of that investment year, Q receives $\frac{4}{9}$ of the total profit, what is the value of x (in Rs.).

[CE-1]

- (A) 8437 (B) 3000
(C) 2500 (D) 4687
- 2.49** In a partnership business the monthly investment by three friends for the first six months is in the ratio 3:4:5 after six months, they had to increase their monthly investments by 10%, 15% and 20% respectively, of their initial monthly investment. The new investment ratio was kept constant for the next six months.
- What is the ratio of their shares in the total profit (in the same order) at the end of the year such that the share is proportional to their individual total investment over the year?

[CE-2]

- (A) 22:23:24 (B) 63:86:110
(C) 22:33:50 (D) 33:46:60
- 2.50** $x : y : z = \frac{1}{2} : \frac{1}{3} : \frac{1}{4}$

What is the value of $\frac{x+z-y}{y} = ?$

[CE-2]

- (A) 1.25 (B) 3.25
(C) 0.75 (D) 2.25

- 2.51** The average of the monthly salaries of M, N and S is Rs. 4000. The average of the monthly salaries of N, S and P is Rs. 5000. The monthly salary of P is Rs. 6000.

What is the monthly salary of M as a percentage of the monthly salary of P?

[ME-1]

- (A) 50% (B) 75%
(C) 100% (D) 125%

2023

IIT Kanpur

- 2.52** A survey of certain year found that 90% of pregnant women received medical care at least once before giving birth. Of these women, 60% received care from doctors, while 40% received from other healthcare providers.

Given this information, which one of the following statements can be inferred with certainty?

[CSE]

- (A) Less than half of pregnant women received medical care at least once from a doctor.
(B) More than half of pregnant women received medical care at least once from a doctor.
(C) Less than half of pregnant women received medical care at most once from a doctor.
(D) More than half of pregnant women received medical care at most once from a doctor.

- 2.53** A recent survey shows that 65% of tobacco users were advised to stop consuming tobacco. The survey also shows that 3 out of 10 tobacco users attempted to stop using tobacco.

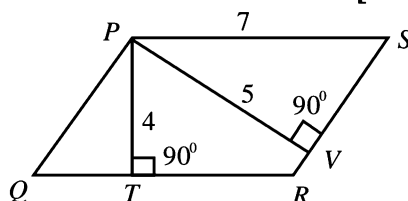
Based only on the interpretation of the above passage, which one of the following options can be logically inferred with certainty?

[EE]

- (A) A majority of tobacco users who were advised to stop consuming tobacco made an attempt to do so.
 (B) A majority of tobacco users who were advised to stop consuming tobacco did not attempt to do so.
 (C) Approximately 30% of the tobacco users successfully stopped consuming tobacco.
 (D) Approximately 65% of tobacco users successfully stopped consuming tobacco.

- 2.54 In the given figure, PQRS is a parallelogram with $PS = 7$ cm, $PT = 4$ cm and $PV = 5$ cm. What is the length of RS in cm? (The diagram is representative.)

[CH, PI]



- (A) $\frac{20}{7}$ (B) $\frac{28}{5}$
 (C) $\frac{8}{2}$ (D) $\frac{35}{4}$

- 2.55 To construct a wall, sand and cement are mixed in the ratio of 3:1. The cost of sand and that of cement are in the ratio of 1:2. If the total cost of sand and cement to construct the wall is 1000 rupees, then what is the cost (in rupees) of cement used?

[CH, PI]

- (A) 400 (B) 600
 (C) 800 (D) 200

2024 IISc Bangalore

- 2.56 Five years ago, the ratio of Aman's age to his father's age was 1 : 4, and five years from now, the ratio will be 2 : 5. What was his father's age when Aman was born ?

[EC]

- (A) 28 years (B) 30 years
 (C) 35 years (D) 32 years

- 2.57 A shopkeeper buys shirts from a producer and sells them at 20% profit. A customer has to pay Rs. 3,186.00 including 18% taxes, per shirt. At what price did the shopkeeper buy each shirt from the producer ?

- (A) Rs. 2,500.00 (B) Rs. 1,975.40
 (C) Rs. 2,250.00 (D) Rs. 2,548.80

[EE]

- 2.58 If, for non-zero real variables x , y and real parameter $a > 1$,

$$x : y = (a+1) : (a-1)$$

Then, the ratio $(x^2 - y^2) : (x^2 + y^2)$ is

- (A) $2a : (a^2 + 1)$ (B) $a : (a^2 + 1)$
 (C) $2a : (a^2 - 1)$ (D) $a : (a^2 - 1)$

[EE]

- 2.59 The ratio of the number of girls to boys in class VIII is the same as the ratio of the number of boys to girls in class IX. The total number of students (boys and girls) in classes VIII and IX is 450 and 360, respectively. If the number of girls in classes VIII and IX is the same, then the number of girls in each class is

- (A) 150 (B) 200
 (C) 250 (D) 175

[IN, CE-2]

- 2.60 A student was supposed to multiply a positive real number p with another positive real number q . Instead, the

student **divided** p by q . If the percentage error in the student's answer is 80%, the value of q is

- (A) 5 (B) $\sqrt{2}$
(C) 2 (D) $\sqrt{5}$

[IN, CE-2]

- 2.61** The number of coins of Rs.1, Rs.5, and Rs.10 denominations that a person has are in the ratio 5:3:13. Of the total amount, the percentage of money in Rs. 5 coins is

- (A) 21% (B) $14\frac{2}{7}\%$
(C) 10% (D) 30%

[CS-1]

- 2.62** For positive non - zero real variables p and q , if

$$\log(p^2 + q^2) = \log p + \log q + 2\log 3$$

then, the value of $\frac{p^4 + q^4}{p^2 q^2}$ is

- (A) 79 (B) 81
(C) 9 (D) 83

[CS-1]

- 2.63** A person sold two different items at the same price. He made 10% profit in one item, and 10% loss in the other item. In selling these two items, the person made a total of

- (A) 1% profit (B) 2% profit
(C) 1% loss (D) 2% loss

[CS-2]

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- 2.64** The 12 musical notes are given as $C, C^\#, D, D^\#, E, F, F^\#, G, G^\#, A, A^\#,$ and B . Frequency of each note is $\sqrt[12]{2}$ times the frequency of the previous note. If the frequency of the note C is 130.8 Hz. then

the ratio of frequencies of notes $F^\#$ and C is : [ECE]

- (A) $\sqrt[6]{2}$ (B) $\sqrt{2}$
(C) $\sqrt[4]{2}$ (D) 2

2.65

An organization allows its employees to work independently on consultancy projects but charges an overhead on the consulting fee. The overhead is 20% of the consulting fee, if the fee is up to ₹5,00,000. For higher fees, the overhead is ₹1,00,000 plus 10% of the amount by which the fee exceeds ₹5,00,000. The government charges a Goods and Services Tax of 18% on the total amount (the consulting fee plus the overhead). An employee of the organization charges this entire amount, i.e., the consulting fee, overhead, and tax, to the client. If the client cannot pay more than ₹10,00,000, what is the maximum consulting fee that the employee can charge? [ECE]

- (A) ₹7,01,438 (B) ₹7,24,961
(C) ₹7,51,232 (D) ₹7,75,784

2.66

Scores obtained by two students P and Q in seven courses are given in the table below. Based on the information given in the table, which one of the following statements is INCORRECT? [EE]

P	22	89	50	45	78	60	39
Q	35	65	60	56	81	45	50

- (A) Average score of P is less than the average score of Q .
(B) Median score of P is same as the median score of Q .
(C) Difference between the maximum and minimum scores of P is greater than the difference between the maximum and minimum scores of Q .
(D) Median score and the average score of Q are same.

- 2.67** Spheres of unit diameter are centered at (l, m, n) where l, m , and n take every possible integer values.

The distance between two spheres is computed from the center of one sphere to the center of the other sphere. For a given sphere, x is the distance to its nearest sphere and y is the distance to its next nearest sphere. The value of $\frac{y}{x}$ is :

[EE]

- (A) $2\sqrt{2}$ (B) $\frac{1}{\sqrt{2}}$
(C) $\sqrt{2}$ (D) 2

- 2.68** ✓ An electricity utility company charges Rs.7 per kWh (kilo watt-hour). If a 40-watt desk light is left on for 10 hours each night for 180 days, what would be the cost of energy consumption? If the desk light is on for 2 more hours each night for the 180 days, what would be the percentage-increase in the cost of energy consumption? [CE-2, XE]

- (A) . 604.8; 10% (B) . 504; 20%
(C) . 604.8; 12% (D) . 720; 15%

- **2.69** ✓ The average marks obtained by a class in an examination were calculated as 30.8.

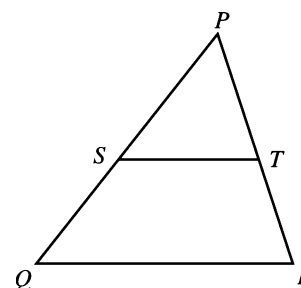
However, while checking the marks entered, the teacher found that the marks of one student were entered incorrectly as 24 instead of 42. After correcting the marks, the average becomes 31.4. How many students does the class have?

[CS-1]

- (A) 25 (B) 28
(C) 30 (D) 32

- 2.70** ✗ In the diagram, the lines QR and ST are parallel to each other. The shortest distance between these two lines is half the shortest distance between the point P and line QR. What is the ratio of the area of the triangle PST to the area of the trapezium SQRT?

Note : The figure shown is representative. [CS-1]



- (A) $\frac{1}{3}$ (B) $\frac{1}{4}$
(C) $\frac{2}{5}$ (D) $\frac{1}{2}$

- **2.71** ✗ Weight of a person can be expressed as a function of their age. The function usually varies from person to person. Suppose this function is identical for two brothers, and it monotonically increases till the age of 50 years and then it monotonically decreases. Let a_1 and a_2 (in years) denote the ages of the brothers and $a_1 < a_2$.

Which one of the following statements is correct about their age on the day when they attain the same weight? [PI, DA]

- (A) $a_1 < a_2 < 50$
(B) $a_1 < 50 < a_2$
(C) $50 < a_1 < a_2$
(D) Either $a_1 = 50$ or $a_2 = 50$

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- 2.72 Real numbers y , p , and n (all greater than 1) satisfy

✗

$$(\log_{p^{1/n}} y)(\log_{y^{1/n}} p) = 16$$

Where the logarithms are taken to the bases $p^{1/n}$ and $y^{1/n}$.

The value of n is _____. [EC]

- (A) 2 (B) 4
(C) 8 (D) 16

- 2.73 Let P_k represent the perimeter of a square with sides of length k . The value of the expression $P_1 + P_2 + P_3 + \dots + P_{10}$ is _____. [EC]

✗

- (A) 55 (B) 110
(C) 220 (D) 440

- 2.74 At how many points will the curves $y = x^2$ and $y = -x^2 - 2x - 1$ intersect in the real (x, y) plane? [EE, PI, CE-1]

✗

- (A) 0 (B) 1
(C) 2 (D) 3

- 2.75 If a positive real x satisfies the following equation

●

$$\log_2 x + \log_{\sqrt{2}} x = 48$$

then the value of x is _____. [CE-2, ME]

- (A) 2^{16} (B) 4^{16}
(C) 2^{14} (D) 4^{14}

- 2.76 The table lists the unit selling price of five products P, Q, R, S, and T. On a particular day, 250 items were sold with the average selling price of Rs. 60.

✗

[CE-2, ME]

The following observations were made :

- (i) The quantity of S sold was twice that of T.

- (ii) The quantity of R sold was thrice that of T.

- (iii) The quantity of Q sold was four times that of T.

Product	P	Q	R	S	T
Unit selling price (Rs.)	10	50	40	60	60

What is the quantity of product P sold on that day?

- (A) 40 (B) 50
(C) 60 (D) 70

- 2.77 The 2nd of June is a Thursday in a certain year. Which day of the week is the 3rd of July in that year?

- (A) Thursday (B) Friday
(C) Saturday (D) Sunday

[IN, XE]

- 2.78 The values of Stock A and Stock B on a particular day are Rs. 50 and Rs. 80, respectively. An investor invests Rs. 100 in Stock A and Rs. 80 in Stock B. He sells all the stocks the next day when the value of Stock A is Rs. 55 and Stock B is Rs. 70. The profit made by the investor is Rs.

✓

[CS-2]

- (A) 0 (B) 5
(C) 10 (D) 20

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- 2.79 Five integers are picked from 0 to 20, with possible repetitions, such that their mean is 12, median is 18, and they have a single mode of 20.

●

Ignoring permutations, the number of ways to pick these five integers is

[DA]

- (A) 0 (B) 1
(C) 2 (D) 3

Engineering Services Examination (ESE)

1. Three hundred Passengers are traveling in white, silver and black cars, each of these cars is carrying 6, 5 and 3 passengers respectively. If the number of white and silver cars is equal and there is only one black car, what is the total number of cars?

(A) 52 (B) 53
(C) 54 (D) 55

[ESE 2017]

2. The present ages of 3 brothers are in the proportion 3 : 4 : 5. After 10 years the sum of their ages will be 78. What are their ages now?

(A) 12, 16 and 20 (B) 15, 20 and 25
(C) 21, 28 and 35 (D) 24, 32 and 40

[ESE 2017]

3. A total of 324 notes comprising of Rs.20 and Rs.50 denominations make a sum of Rs.12,450. The number of Rs.20 notes is

(A) 200 (B) 144
(C) 125 (D) 110

[ESE 2017]

4. Rajiv spends 40% of his salary on food, 20% on house rent, 10% on entertainment and 10% on conveyance. If his saving at the month end are Rs.2,000, then his monthly salary is :

(A) 6,000 (B) 8,000
(C) 10,000 (D) 12,000

[ESE 2017]

5. A man sold a chair and a table together for Rs.7,600; thereby making a profit of 25% on the chair and 10% on the table. By selling them together for Rs.7,500 he would make a profit of 10% on the chair and 20% on the table. Then the cost price of chair and table will be :

(A) Rs.3000 and Rs.4000
(B) Rs.3500 and Rs.4000
(C) Rs.3000 and Rs.3500
(D) Rs.3500 and Rs.3500

[ESE 2019]

6. A student purchases some books for Rs. 1600. If he had bought 8 more books for the same amount, each book would cost Rs.10 less. The number of books he buys is :

(A) 30 (B) 32
(C) 34 (D) 36

[ESE 2019]

7. A rod of length l is to be divided into two parts, such that if 5 times the smaller portion is added to half of the larger portion, it will always be less than l . This can be achieved by taking length of the larger portion more than :

(A) $\frac{9}{10}l$ (B) $\frac{7}{8}l$
(C) $\frac{6}{7}l$ (D) $\frac{5}{6}l$

[ESE 2019]

8. If the nominal rate of interest is 12% and is compounded quarterly, the effective rate of interest per annum will be nearly :

(A) 10.8% (B) 12.6%
(C) 14.4% (D) 16.2%

[ESE 2020]

9. In how many years will a sum of ₹ 800 at 10% per annum compounded semi-annually become ₹ 926.10 ?

(A) $1\frac{1}{3}$ years (B) $1\frac{1}{2}$ years
(C) $2\frac{1}{3}$ years (D) $2\frac{1}{2}$ years

[ESE 2021]

10. The population of a village is 5500. If the number of males increases by 11% and the number of females increases by 20% then the population becomes 6330. The population of female in the village is

(A) 2000 (B) 2500
(C) 3000 (D) 3500

[ESE 2021]

11. Rohith spends 40% of his monthly income on food items and 50% of the remaining on clothes and conveyance. He saves one-third of the remaining amount after spending on food, clothes and conveyance. If he saves 19,200 every year, what is his monthly income?

(A) 32,000 (B) 16,000
(C) 12,000 (D) 6,000

[ESE 2022]

12. The difference between simple interest and compound interest on a sum for 2 years at 8% when the interest is compounded annually is 16. If the interest were compounded half yearly the difference in two interests would be nearly

(A) 21.35 (B) 24.64
(C) 27.85 (D) 29.94

[ESE 2022]

13. The weight of 3 mangoes and 2 apples is 255 grams. The weight of 2 mangoes and 3 apples is 285 grams. Each mango weighs the same and each apple weighs the same. The combined weight of 1 mango and 1 apple will be

(A) 98 grams (B) 104 grams
(C) 108 grams (D) 114 grams

[ESE 2025]

14. One student gets 20% of marks in an examination and fails by 30 marks.

Another student secures 32% of marks and gets 42% marks more than that required to pass. The percentage of marks required to pass in that examination will be

(A) 22% of marks
(B) 25% of marks
(C) 28% of marks
(D) 30% of marks

[ESE 2025]

15. The value of a machine depreciates every year by 5%. If the present value of the machine be 100,000, its value after 3 years will be nearly

(A) Rs. 95,198
(B) Rs. 90,376
(C) Rs. 87,556
(D) Rs. 85,738

[ESE 2025]

16. A man spends $\frac{2}{5}$ of his salary on groceries and $\frac{3}{10}$ of the remaining on his clothes. If he saves Rs. 10,500, his monthly salary will be

(A) Rs. 30,000 (B) Rs. 15,000
(C) Rs. 20,000 (D) Rs. 25,000

[ESE 2025]

17. For many alloy systems at specific temperature, a maximum concentration of solute atoms that dissolve in the solvent to form a solid solution is

(A) Equilibrium of alloy
(B) Free energy
(C) System

(D) Solubility limit

[ESE 2025]

18. Consider a square of side 6 cm, a circle is inscribed inside the square. Another circle circumscribes the square. The ratio of the areas of the inscribed circle to the circumscribed circle is

(A) $1 : \frac{\pi}{4}$

(B) $1 : \pi$

(C) $1 : 15$

(D) $1 : 2$

[ESE 2026]

Answers

Average, Percentage & Ratio

2.1	D	2.2	A	2.3	D	2.4	B	2.5	D
2.6	A	2.7	B	2.8	850	2.9	48	2.10	C
2.11	D	2.12	A	2.13	1300	2.14	D	2.15	C
2.16	2.065	2.17	C	2.18	2006	2.19	D	2.20	A
2.21	D	2.22	D	2.23	C	2.24	B	2.25	B
2.26	C	2.27	C	2.28	B	2.29	B	2.30	B
2.31	C	2.32	C	2.33	D	2.34	C	2.35	A
2.36	B	2.37	C	2.38	B	2.39	A	2.40	B
2.41	C	2.42	B	2.43	B	2.44	D	2.45	C
2.46	D	2.47	B	2.48	B	2.49	B	2.50	A
2.51	A	2.52	B	2.53	B	2.54	B	2.55	A
2.56	B	2.57	C	2.58	A	2.59	B	2.60	D
2.61	C	2.62	A	2.63	C	2.64	B	2.65	B
2.66	B	2.67	C	2.68	B	2.69	C	2.70	A
2.71	B	2.72	B	2.73	C	2.74	A	2.75	A
2.76	B	2.77	D	2.78	A	2.79	B		
Engineering Services Examination (ESE)									
1.	D	2.	A	3.	C	4.	C	5.	C
6.	B	7.	A	8.	B	9.	B	10.	D
11.	B	12.	B	13.	C	14.	A	15.	D
16.	D	17.	D	18.	D				

Explanations

Average, Percentage & Ratio

2.1 (D)

Net compound rate of 10% for 2 years

$$= 10\% + 10\% + \frac{100}{100}\% = 21\%$$

Therefore, the amount after 2 years

$$= 1000 + 21\% \text{ of } 1000 = \text{Rs.}1210$$

As per the given conditions,

Principal = Rs.1210

Time = 5 years

Rate = 12% @ SI

Therefore, new amount

$$= \text{Rs.}1210 + 60\% \text{ of Rs.}1210$$

$$= \text{Rs.}1210 + 726 = \text{Rs.}1936$$

Hence, the correct option is (D).

Key Point

1. Compound interest rate is also applied on previous year's Interest.
2. Simple Interest remains same for every year.

2.2 (A)

Let there be overall 'x' voters. Initially those who decided to vote for P and Q are 0.4x and 0.6x respectively.

On the day of election,

15% of 0.4x = 0.06x went from P's side to Q's side and 25% of 0.6x = 0.15x went from Q's side to P's side.

Now after transfer of votes, 'P' has

$$0.4x - 0.06x + 0.15x = 0.49x$$

and after transfer of votes, 'Q' has

$$0.6x - 0.15x + 0.06x = 0.51x$$

According to question, 'P' lost by 2 votes.

$$Q - P = 2 \text{ Votes}$$

$$0.51x - 0.49x = 2 \text{ Votes}$$

$$0.02x = 2 \text{ Votes}$$

$$x = 100 \text{ Voters}$$

Hence, the correct option is (A).

2.3 (D)

Total budget

$$= 4000 + 1200 + 2000 + 1500 + 1800$$

$$= 10500$$

Expenditure other than savings

$$= 10500 - 1500 = 9000$$

% of monthly budget NOT spent on saving

$$= \frac{9000}{10500} \times 100 = 86\%$$

Hence, the correct option is (D).

2.4 (B)

Given :

Player	2009	2010
P	802	1008
Q	765	912
R	429	619
S	501	701

% increase is defined as :

$$\left(\frac{\text{Final value} - \text{initial value}}{\text{Initial value}} \right) \times 100\%$$

From the given data,

$$P = \frac{206}{802} \times 100\% = 25.68\%$$

$$Q = \frac{147}{765} \times 100\% = 19.21\%$$

$$R = \frac{190}{429} \times 100\% = 44.28\%$$

$$S = \frac{200}{501} \times 100\% = 39.92\%$$

In comparison between P, Q, R and S the lowest increase is for Q.

Hence, the correct option is (B).

2.5 (D)

According to given data,

Increase in raw material,

$$= \frac{6240 - 5200}{5200} \times 100 = 20\%$$

Increase in power and fuel

$$= \frac{9450 - 7000}{7000} \times 100 = 35\%$$

Increase in salary and wages

$$= \frac{12600 - 9000}{9000} \times 100 = 40\%$$

Increase in plant and machinery

$$= \frac{25000 - 20000}{20000} \times 100 = 25\%$$

Increase in advertising

$$= \frac{19500 - 15000}{15000} \times 100 = 30\%$$

Increase in research and development

$$= \frac{26400 - 22000}{22000} \times 100 = 20\%$$

Category	2010	2011	% increase
Raw material	5200	6240	20
Power and fuel	7000	9450	35
Salary and wages	9000	12600	40
Plant and machinery	20000	25000	25
Advertising	15000	19500	30
Research and development	22000	26400	20

Therefore, the two categories that have registered by same percentage are raw material and research and development.

Hence, the correct option is (D).

2.6 (A)**Given :**

- (i) Selling price per unit, $SP = 60/\text{unit}$
 (ii) Total cost price, $CP_T = 100$
 (iii) Initial total profit, $P_T = 500$

Total selling price = Total cost price + Profit_T

$$SP_T = CP_T + P_T$$

$$SP_T = 100 + 500 = 600$$

If total number of unit produced is x , then

$$x \times 60 = 600$$

$$x = 10$$

$$\text{New cost price, } CP'_T = 100 + 100 \times \frac{30}{100} = 130$$

New profit, $P'_T = 500$

$$SP'_T = CP'_T + P'_T$$

$$10 \times SP' = 130 + 500 = 630$$

$$SP' = 63$$

$$\text{Increase in selling price} = \frac{63 - 60}{60} \times 100\% = 5\%$$

Hence, the correct option is (A).

2.7 (B)**Given :** The industrial consumption of power doubled from 2000-2001 to 2010-2011.Thus, let $n = 10$ year, $A = 2P$

The relation between amount, principal, rate and numbers of years is,

$$A = P \left[1 + \frac{r}{100} \right]^n$$

$$2P = P \left[1 + \frac{r}{100} \right]^{10}$$

$$2 = \left[1 + \frac{r}{100} \right]^{10}$$

$$r = 7.2\%$$

Hence, the correct option is (B).

2.8 850

One way single person fare = Rs. 100

Total two way trip fare for 5 persons

$$= (2 \times 100) \times 5 = \text{Rs. } 1000$$

Round trip (two way trip) discount,

$$= 10\% \text{ of the total fare}$$

$$= 10\% \text{ of Rs. } 1000 = \text{Rs. } 100$$

Group discount = 5% of total fare

$$= 5\% \text{ of Rs. } 1000 = \text{Rs. } 50$$

Thus, total discount

$$= \text{Rs. } 100 + \text{Rs. } 50 = \text{Rs. } 150$$

So, the net charge of 5 persons in two way trip

$$= \text{Rs. } 1000 - \text{Rs. } 150 = \text{Rs. } 850$$

Hence, the correct answer is **850**.**2.9 48**

Total number of persons = 300

Vehicles	Persons (Men + Women)
Car	40 + 34 = 74
Scooter	30 + 20 = 50
Both car and scooter	60 + 46 = 106
Do not own vehicle	20 + 50 = 70

Total number of person who do not own a scooter = $74 + 70 = 144$

% Respondents who do not own a scooter

$$= \frac{\text{Number of person who do not own scooter}}{\text{Total number of person}}$$

$$= \frac{144}{300} \times 100 = 48\%$$

Hence, the correct answer is **48**.**2.10 (C)****Given :**

Q. No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1.	2	21	17	6
2	3	15	27	2
3	2	23	18	3

From the above table :

- (i) For Question No. (1),
Total number of students
= 21 + 17 + 6 = 44
- (ii) For Question No. (2),
Total number of students
= 15 + 27 + 2 = 44
- (iii) For Question No. (3),
Total number of students
= 23 + 18 + 3 = 44

So, there are a total of 44 students only.

Marks obtained by all the 44 students :

- (i) For Question No. (1),
= 21 × 2 = 42
- (ii) For Question No. (2),
= 15 × 3 = 45
- (iii) For Question No. (3),
= 23 × 2 = 46

Average marks

$$= \frac{\text{Total marks}}{\text{Total number of students}} \\ = \frac{42 + 45 + 46}{44} = \frac{133}{44} = 3.02$$

Hence, the correct option is (C).

2.11 (D)

Let gross domestic product during 2012-2013 increases from USD 'x' to USD 'y'.

The exchange rate Rs. 50 /USD changes to Rs. 60 /USD.

So, the GDP increases from 50x to 60y and increment rate of this is 7%,

$$\begin{aligned} \text{Thus, } \frac{60y - 50x}{50x} &= 0.07 \\ 60y - 50x &= 3.5x \\ 60y &= 53.5x \\ y &= 0.8916x \end{aligned}$$

Therefore, the GDP grows at

$$\begin{aligned} &= \frac{y - x}{x} \times 100 = \frac{0.8916x - x}{x} \times 100 \\ &= -10.83\% \end{aligned}$$

[– ve sign indicates decrease in GDP]

It has decreased by 10.83% ≈ 11%

Hence, the correct option is (D).

2.12 (A)

Given : Population of the city = 5 million

Annual growth in population = 20%

Method 1

After one year, population,

$$x_1 = 5 + 5 \times \frac{20}{100} = 6 \text{ million}$$

After two years, population,

$$x_2 = x_1 + x_1 \times \frac{20}{100} = 6 + \frac{6}{5} = 7.2 \text{ million}$$

After three years, population,

$$x_3 = x_2 + x_2 \times \frac{20}{100}$$

$$x_3 = 7.2 + \frac{7.2}{5} = 8.64 \text{ million}$$

After four years, population,

$$x_4 = x_3 + x_3 \times \frac{20}{100}$$

$$x_4 = 8.64 + \frac{8.64}{5} = 10.368 \text{ million}$$

Between third and fourth year, the population doubles i.e. becomes 10 million.

Hence, the correct option is (A).

Method 2

The law of natural growth and decay is given by,

$$\frac{dx}{dt} \propto x \quad [\text{For growth}] \quad \dots(i)$$

$$\frac{dx}{dt} \propto -x \quad [\text{For decay}]$$

From equation (i),

$$\frac{dx}{dt} = kx \Rightarrow \frac{dx}{x} = k dt$$

Integrating both sides,

$$\ln x = kt + C \quad \dots(ii)$$

where, k and C are constants.

x represents the population of the city and t is time.

Initially ($t = 0$), population is 5 million.

$$\ln(5 \times 10^6) = 0 + C$$

$$C = 15.42 \quad \dots(iii)$$

At $t = 1$, population grows 20%.

$$x' = 5 + 5 \times \frac{20}{100} = 6 \text{ million}$$

From equation (ii),

$$\ln x' = kt + C$$

$$\ln(6 \times 10^6) = k \times 1 + 15.42$$

$$k = 15.60 - 15.42 = 0.18 \quad \dots(iv)$$

Now, for population to double i.e. $x = 10$ million,

From equations (ii), (iii) and (iv),

$$\ln(10 \times 10^6) = 0.18 \times t + 15.42$$

$$0.18t = 0.69$$

$$t = 3.84$$

Therefore, the population will double in between three to four years.

Hence, the correct option is (A).

2.13 1300

Given :

(i) Fixed daily cost = 50,000

(ii) Variable cost = $800Q$

where, Q = daily production in tonnes.

For daily production of 100 tonnes,

Variable cost = $800 \times 100 = 80,000$

Total cost

= Fixed daily cost + Variable daily cost

$$C_T = 50,000 + 80,000$$

$$C_T = 1,30,000$$

Total cost for 100 tonnes = 1,30,000

So, cost of production per tonne

$$= \frac{1,30,000}{100} = 1300 \text{ Rs.}$$

Hence, the cost of production in Rs. Per tonne for a daily production of 100 tonnes is **1300** Rs.

2.14 (D)

Given :

- (i) Country X has 1% of people taller than 6ft.
- (ii) Country Y has 2% of people taller than 6ft.
- (iii) Country X has thrice as many people in country Y .

Let population of Y be 100. Then X 's population is 300.

Total number of people in both country = 400

Total number of people taller than 6ft in both countries,

$$T = \frac{X \times \frac{1}{100} + Y \times \frac{2}{100}}{400}$$

$$T = \frac{300 \times \frac{1}{100} + 100 \times \frac{2}{100}}{400}$$

$$\%T = \frac{5}{400} \times 100\% = 1.25\%$$

Hence, the correct option is (D).

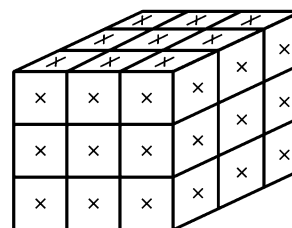
2.15 (C)

Total volume of cube = 3^3

= 27 cubic unit

Volume of each small cube = $1^3 = 1$ cubic unit

Total number of smaller cubes = $\frac{27}{1} = 27$



Number of faces in each cube = 6

Total number of faces in smaller cubes

$$= 27 \times 6 = 162$$

Number of visible faces in smaller cubes

$$= 9 \times 6 = 54 \quad (9 \text{ on each face} \times 6 \text{ faces})$$

Number of faces which are not visible

$$= (\text{Total face}) - (\text{Visible face})$$

$$= 162 - 54 = 108$$

$$\text{Required ratio} = \frac{\text{Visible faces}}{\text{Non-visible faces}} = \frac{54}{108} = \frac{1}{2}$$

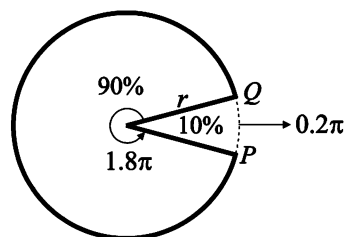
Required ratio = 1:2

Hence, the correct option is (C).

2.16 2.065

Radius of sheet of paper $r = 30$ cm

If a sector of 10% area is removed



The area of remaining 90% paper,

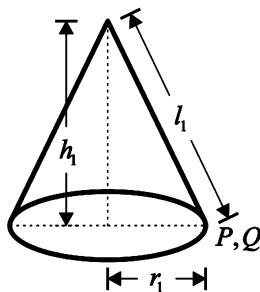
$$A = 0.9 \times \pi r^2 = 0.9\pi \times (30)^2 \text{ cm}^2 \quad \dots(i)$$

The perimeter of remaining 90% paper,

$$P = 0.9 \times 2\pi r = 1.8\pi \times 30 \text{ cm} \quad \dots(ii)$$

When it is made into a conical surface by connecting points P and Q .

Let, the radius and height of cone are r_1 and h_1 respectively.



The perimeter of base (circle of radius r_1)

$$= 2\pi r_1 = P \quad [\text{From equation (ii)}]$$

$$2\pi r_1 = 1.8\pi r$$

$$r_1 = 0.9r = 0.9 \times 30 = 27 \text{ cm}$$

Curved surface area of the cone,

$$A_1 = \pi r_1 l_1 = \pi r_1 \sqrt{r_1^2 + h_1^2} = A$$

[From equation (i)]

$$\pi r_1 \sqrt{r_1^2 + h_1^2} = 0.9\pi r^2$$

$$r_1^2 \sqrt{1 + \left(\frac{h_1}{r_1}\right)^2} = 0.9r^2$$

$$(0.9r)^2 \sqrt{1 + \left(\frac{h_1}{r_1}\right)^2} = 0.9r^2$$

$$\sqrt{1 + \left(\frac{h_1}{r_1}\right)^2} = \frac{1}{0.9}$$

$$1 + \left(\frac{h_1}{r_1}\right)^2 = \left(\frac{1}{0.9}\right)^2$$

$$\left(\frac{h_1}{r_1}\right)^2 = \left(\frac{1}{0.9}\right)^2 - 1$$

$$\left(\frac{h_1}{r_1}\right)^2 = 0.2345$$

$$\frac{h_1}{r_1} = 0.4842$$

$$\frac{r_1}{h_1} = 2.065$$

Hence, the ratio of radius and height of cone is **2.065**.

2.17 (C)

Given :

There are total five questions and there is no negative marking for wrong answer.

Q. No.	Marks	Answered correctly	Total students (Answered correctly + Answered wrongly + Not attempted)	Total marks
1	2	21	21+17+6 = 44	42
2	3	15	15+27+2 = 44	45
3	1	11	11+29+4 = 44	11
4	2	23	23+18+3 = 44	46
5	5	31	31+12+1 = 44	155

So, there are a total of 44 students only.

Marks obtained by all the 44 students :

- (i) For Question No. (1),
= $21 \times 2 = 42$
- (ii) For Question No. (2),
= $15 \times 3 = 45$
- (iii) For Question No. (3),
= $11 \times 1 = 11$
- (iv) For Question No. (4),
= $23 \times 2 = 46$
- (v) For Question No. (5),
= $31 \times 5 = 155$

Average marks

$$= \frac{\text{Total marks}}{\text{Total number of students}} = \frac{42 + 45 + 11 + 46 + 155}{44} = \frac{299}{44} = 6.795$$

Hence, the correct option is (C).

2.18 2006

According to the given graph below shown table can be drawn,

In the year 2001,

% Increase in imports,

$$\frac{50 - 40}{40} \times 100\% = 25\%$$

% Increase in exports,

$$\frac{60 - 50}{50} \times 100\% = 20\%$$

In the year 2002,

% Increase in imports,

$$\frac{60 - 50}{50} \times 100\% = 20\%$$

% Increase in exports,

$$\frac{70 - 60}{60} \times 100\% = 16.67\%$$

In the year 2003,

% Increase in imports,

$$\frac{70 - 60}{60} \times 100\% = 16.67\%$$

% Increase in exports,

$$\frac{60 - 70}{70} \times 100\% = -14.2\%$$

In the year 2004,

% Increase in imports,

$$\frac{80 - 70}{70} \times 100\% = 14.2\%$$

% Increase in exports,

$$\frac{70 - 60}{60} \times 100\% = 16.67\%$$

In the year 2005,

% Increase in imports,

$$\frac{90 - 80}{80} \times 100\% = 12.5\%$$

% Increase in exports = 0%

In the year 2006,

% Increase in imports,

$$\frac{120 - 90}{90} \times 100\% = 33.34\%$$

% Increase in exports,

$$\frac{100 - 70}{70} \times 100\% = 42.8\%$$

In the year 2007,

% Increase in imports = 0%

% Increase in exports,

$$\frac{110 - 100}{100} \times 100\% = 10\%$$

Year %	% Increase in imports	% Increase in exports	Total % increase
2001	25%	20%	45%
2002	20%	16.67%	36.67%
2003	16.67%	-14.2%	2.47%
2004	14.2%	16.67%	30.87%
2005	12.5%	0%	12.5%
2006	33.34%	42.8%	76.14%
2007	0%	10%	10%

From above table, it is clear that years **2006** is the year with highest combined % increase in import and export.

2.19 (D)

Growth rate is given by $= \frac{\text{Final} - \text{Initial}}{\text{Initial}} \times 100\%$

From the given table,

Type I batteries,

$$\text{Growth rate} = \frac{115 - 75}{75} \times 100\% = 53.3\%$$

Type II batteries,

$$\text{Growth rate} = \frac{85 - 144}{144} \times 100\% = -40.97\%$$

(negative sign indicates decay)

Type III batteries,

$$\text{Growth rate} = \frac{160 - 114}{114} \times 100\% = 40.35\%$$

Type IV batteries,

$$\text{Growth rate} = \frac{100 - 102}{102} \times 100\% = -1.96\%$$

(negative sign indicates decay)

Type V batteries,

$$\text{Growth rate} = \frac{145 - 108}{108} \times 100\% = 34.25\%$$

Therefore, Type I batteries has the highest growth between years 2006 and 2012.

Hence, the correct option is (D).

2.20 (A)

$$\begin{aligned} (x\% \text{ of } y) + (y\% \text{ of } x) &= \frac{x}{100} \times y + \frac{y}{100} \times x \\ &= \frac{xy + xy}{100} = \frac{2xy}{100} \\ &= 2\% \text{ of } xy \end{aligned}$$



Hence, the correct option is (A).

2.21 (D)

From given graph, in year 2006,

Rate of interest offered by $P = 6\%$

Rate of interest offered by $Q = 4\%$

Ratio of amount invested in the companies is 8 : 9 i.e. let $8x$ and $9x$ be amount invested by P and Q .

Interest offered by P in one year,

$$I_P = \frac{8x \times 6 \times 1}{100} \quad \dots (i)$$

Interest offered by Q in one year,

$$I_Q = \frac{9x \times 4 \times 1}{100} \quad \dots (ii)$$

From equation (i) and (ii),

$$\frac{I_P}{I_Q} = \frac{48}{36} = \frac{4}{3}$$

Hence, the correct option is (D).

2.22 (D)

Let H be household water consumption and P be other water consumption.

Total water consumption initially $= H + P$

After 25% decrement in overall water consumption,

Therefore, New overall water consumption $= 0.75 (H + P)$

After 20% decrement in household water consumption,

New household water consumption $= 0.8 H$

After 70% increment in other water consumption,

New other water consumption $= 1.7 P$

According to given condition :

New household water consumption

+ New other water consumption

= New overall water consumption

$$0.8H + 1.7P = 0.75(H + P)$$

$$0.05H = -0.95P$$

$$\frac{H}{P} = -19$$

Ratio cannot be negative.

So, there are errors in the official's statement.

Hence, the correct option is (D).

2.23 (C)

Given : Radius of cone is increased by 50%.

Volume of cone is given by,

$$V = \frac{1}{3}\pi r^2 h$$

Where, r = radius of circular surface of cone.

h = height

Now, r is increased by 50%.

So $r' = r + 0.5r = 1.5r$

$$V' = \frac{1}{3}\pi r'^2 h = \frac{1}{3}\pi(1.5r)^2 h$$

$$V' = 2.25 \times \frac{1}{3}\pi r^2 h$$

$$V' = \frac{1}{3}\pi r^2 h + 1.25 \times \frac{1}{3}\pi r^2 h$$

$$V' = V + 1.25V$$

Therefore, volume increases by 125%.

Hence, the correct option is (C).

2.24 (B)

Let the quantity of A and B each be 10 gm

$$\text{Mass of gold in alloy A} = \frac{2 \times 10}{2+3} = \frac{2 \times 10}{5} = 4 \text{ gm}$$

and Mass of copper in alloy A

$$= \frac{3 \times 10}{3+2} = \frac{3 \times 10}{5} = 6 \text{ gm}$$

$$\text{Mass of gold in alloy B} = \frac{3 \times 10}{3+7} = \frac{3 \times 10}{10} = 3 \text{ gm}$$

and Mass of copper in alloy B

$$= \frac{7 \times 10}{7+3} = \frac{7 \times 10}{10} = 7 \text{ gm}$$

Total quantity of gold in alloy C = 4 + 3 = 7 gm

Total quantity of copper in alloy C

$$= 6 + 7 = 13 \text{ gm}$$

The required ratio of alloy C = 7 : 13

Hence, the correct option is (B).

Key Point

If two alloys of ratio $A : B$ and $C : D$ are mixed together, the new ratio of alloys is given by,

$$\frac{A}{A+B} + \frac{C}{C+D} : \frac{B}{A+B} + \frac{D}{C+D}$$

2.25 (B)

Given :

Amount A = Rs. 1000000,

Rate of compound interest $r = 10\%$,

Time period $n = 5$ years

$$\text{Amount } A = P \left(1 + \frac{r}{100} \right)^n$$

$$1000000 = P \left(1 + \frac{10}{100} \right)^5 = P(1.1)^5$$

$$P = \frac{1000000}{1.61} = \text{Rs. } 621118.0124 \approx \text{Rs. } 621000$$

Hence, the correct option is (B).

2.26 (C)

Assume a total of 100 marbles each of cost 1 unit.

Blue marbles = 40

Black marbles = 25

Red marbles = 20

Yellow marbles = 15

Let x marbles are reduced from each type and cost of each marble is 1.25 unit.

Total cost should remain 100.

$$(40 - x)1.25 + (25 - x)1.25 + (20 - x)1.25 + (15 - x)1.25 = 100$$

$$125 - 5x = 100$$

$$x = 5$$

Therefore, Blue marbles = $40 - 5 = 35$

Black marbles = $25 - 5 = 20$

Red marbles = $20 - 5 = 15$

Yellow marbles = $15 - 5 = 10$

Total number of marbles (modified) = 80

$$\% \text{ Blue marbles} = \frac{35}{80} \times 100 = 43.75\%$$

Hence, the correct option is (C).

2.27 (C)

Let the cost price be x . The seller sold the fruits at 12.5 % loss.

$$\text{So, Selling price} = x - x \times \frac{12.5}{100}$$

$$SP = 0.875x$$

Let new selling price be SP' with 10 % Gain.

$$\text{So, } SP' = 0.875x + 108$$

$$\text{Gain} = \frac{SP' - CP}{CP} \times 100\%$$

$$10 = \frac{0.875x + 108 - x}{x} \times 100$$

$$\frac{x}{10} = -0.125x + 108$$

$$2.25x = 1080$$

$$x = 480 \text{ Rs}$$

12.5% loss when cost price is 480.

$$\text{loss} = 480 \times \frac{12.5}{100} = 60 \text{ Rs}$$

Hence, the correct option is (C).

2.28 (B)

Given :

- (i) Price is proportional to square of length of wire i.e. $P \propto L^2$.

$$(ii) P_1 = 1600, L_1 = 10 \text{ m}, L_2 = 4 \text{ m}, L_3 = 6 \text{ m}$$

$$\frac{P_1}{P_2} = \frac{L_1^2}{L_2^2}$$

$$\frac{1600}{P_2} = \frac{10^2}{4^2}$$

$$P_2 = \frac{1600 \times 16}{100} = 256$$

$$\frac{P_1}{P_3} = \frac{L_1^2}{L_3^2} \Rightarrow \frac{1600}{P_3} = \frac{10^2}{6^2}$$

$$P_3 = \frac{1600 \times 36}{100} = 576$$

$$P_2 + P_3 = 256 + 576 = 832$$

Hence, the correct option is (B).

2.29 (B)

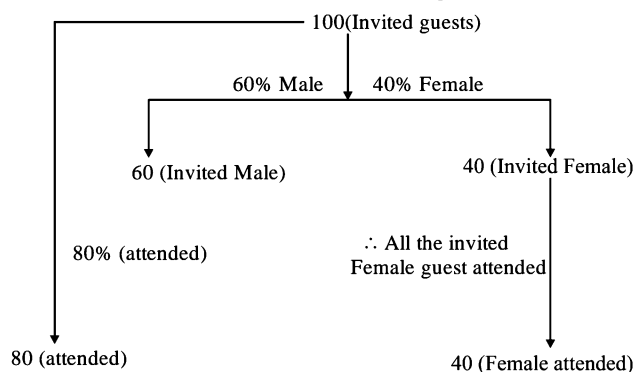
Given :

Let total number of invited guest = x

Number of male = $0.6x$

Number of female = $0.4x$

Assume, total number of invited guests = 100



Total Attended

$$= \text{Male attended} + \text{Female attended}$$

$$80 = \text{Male attended} + 40$$

$$\downarrow$$

$$40$$

Thus, the ratio of males to females = 1 : 1

Hence, the correct option is (B).

2.30 (B)

Let population of X in 2001 be 100% and population of Y in 2001 be 100%.

In 2011 population of X increased by $x\%$ i.e. population of $X = 100 + x$.

In 2011 population of Y increased by $y\%$ i.e. population of $Y = 100 + y$.

Ratio of population of X and Y in 2001,

$$P = 1$$

Ratio of population of X and Y in 2011,

$$P' = \frac{100 + x}{100 + y}$$

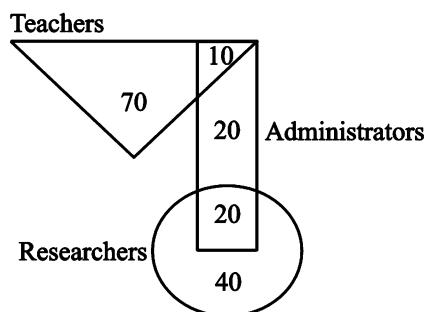
Percentage increase in

$$P = \frac{\frac{100 + x}{100 + y} - 1}{1} \times 100 = \frac{100(x - y)}{100 + y}$$

Hence, the correct option is (B).

2.31 (C)

Given :



Total number of people

$$= 70 + 10 + 20 + 20 + 40 = 160$$

Out of which number of people who are

administrators = $10 + 20 + 20 = 50$

$$\% \text{ of administrators} = \frac{50}{160} \times 100 = 31.25\%$$

Hence, the correct option is (C).

2.32 (C)

Let the total population in 2001 = 100

Given that the population is not changed. So the population in 2011 = 100.

Given proportion of males in females in 2001 = 60% and 40% respectively

So, Total males = 60

Total females = 40

Illiterate males in 2001 = 50 % of 60 = 30

Illiterate females in 2001 = 60 % of 40 = 24

Total illiterates = 30 + 24 = 54

Total literates in 2001 = 100 - 54 = 46 ... (i)

Also, given proportion of males and females in 2011 = 50% and 50%.

So, Total males = 50

Total females = 50

Number of illiterates males = 40% of 50 = 20

Number of illiterates females = 40% of 50 = 20

Total illiterates = 20 + 20 = 40

Total number of literates in 2011

$$= 100 - 40 = 60 \quad \dots (ii)$$

Increase in literates from equation (i) and (ii),

$$= 60 - 46 = 14$$

$$\% \text{ increase in literates} = \frac{14 \times 100}{46} = 30.43\%$$

Hence, the correct option is (C).

2.33 (D)

Given : Ratio of number of boys to girls who participated in the examination = 4 : 3

Let, total students participated in the examination

$$= 4x + 3x = 7x$$

Given, total percentage of passing candidates

$$= 80\%$$

Total number of students passed in the examination

$$= 7x \times \frac{80}{100} = 5.6x$$

and the percentage of girls who passed in the examination = 90%

i.e., number of girls who passed

$$= 3x \times \frac{90}{100} = 2.7x$$

Number of boys who passed in the examination

$$= 5.6x - 2.7x = 2.9x$$

Required percentage of passed boys

$$= \frac{2.9x}{4x} \times 100 = 72.50\%$$

Hence, the correct option is (D).

2.34 (C)

Given : Radius (r) and height (h) of a circular cone increases by 10%

$$\text{Volume of cone } V = \frac{1}{3} \pi r^2 h$$

New radius, $r' = 1.1r$

New height, $h' = 1.1h$

$$\text{New Volume, } V' = \frac{1}{3} \pi (1.1r)^2 (1.1h)$$

$$V' = (1.1)^3 \left[\frac{1}{3} \pi r^2 h \right]$$

% increase in volume

$$= \frac{(1.1)^3 \frac{1}{3} \pi r^2 h - \frac{1}{3} \pi r^2 h}{\frac{1}{3} \pi r^2 h} \times 100\%$$

$$= \frac{(1.1)^3 - 1}{1} \times 100 = 33.1\%$$

Hence, the correct option is (C).

2.35 (A)

Given :

(i) Total population = 1400 million

(ii) Mobile phone owners = $1400 \times \frac{70}{100} = 980$

(iii) Internet net users = 294 million

(iv) Buyers = $\frac{\text{Net users}}{2} = 147 \text{ million}$

% of buyers in the country

$$= \frac{147}{1400} \times 100\% = 10.5\%$$

Hence, the correct option is (A).

2.36 (B)

Let, the first amount = Rs. x and second amount

$$= \text{Rs. } (100000 - x)$$

According to first given condition of question,

$$(100000 - x) \times 12\% + x \times 10\% = 12000 - 0.02x \quad \dots(i)$$

According to second given condition of question,

$$(100000 - x) \times 10\% + x \times 12\% = 10000 + 0.02x \quad \dots(ii)$$

Now, as per the question the difference of equation (i) and (ii) will give the profit of Rs. 120.

$$\text{So, } (12000 - 0.02x) - (10000 + 0.02x) = 120$$

$$2000 - 0.04x = 120$$

$$x = \frac{2000 - 120}{0.04} = \text{Rs. } 47000$$

So, the required ratio

$$= \frac{x}{100000 - x} = \frac{47000}{100000 - 47000} = \frac{47}{53}$$

Hence, the correct option is (B).

2.37 (C)

Given :

(i) Total employees in 2010 is 600.

(ii) Employees increased by 15% in 2016.

Total employees in 2016

$$= 600 + 600 \times \frac{15}{100} = 690 \quad \dots(i)$$

Employees in S category in 2010

$$= 600 \times \frac{25}{100} = 150$$

Now, S category increased by 40% in 2016

Employees in S category in 2016

$$= 150 + 150 \times \frac{40}{100} = 210 \quad \dots(ii)$$

Since, there is no change in P, Q, and R categories of employees so total number of employees of all three categories is given by,

Number of employees

$$= 600 \times \frac{20}{100} + 600 \times \frac{25}{100} + 600 \times \frac{25}{100} = 420$$

So, total number employees in T category

$$= 690 - (420 + 210) = 60$$

Hence, the correct option is (C).

2.38 (B)

Type	Months				Revenue
	Jan	Feb	Mar	Apr	
Pool	170	320	215	190	895
Mini	110	220	180	70	580
Prime	75	180	120	90	465
					Total revenue 1940

% share of revenue contributed by prime to total

$$\text{revenue} = \frac{465}{1940} \times 100 = 23.97.$$

Hence, the correct option is (B).

2.39 (A)

Let us assume GDP is Rs.100 in year 2015 and GDP increased by 10% from 2015 to 2016.

Year	GDP	FD
2015	100	4%
2016	110	5%

Now percentage increase in fiscal deficit.

$$\begin{aligned} \text{Percent change} &= \frac{\text{F.V.} - \text{I.V.}}{\text{I.V.}} \times 100 \\ &= \frac{110 \times 5\% - 100 \times 4\%}{100 \times 4\%} \times 100 \end{aligned}$$

$$\text{Percent change} = \frac{5.5 - 4}{4} \times 100 = 37.50\%.$$

Hence, the correct option is (A).

2.40 (B)

Initial cost of the product = Rs. 120 /unit

After every stage price is increasing by 25% or 1.25 and there is total 5 stage including customer stage.

$$\begin{aligned} \therefore \text{The price paid by the customer} \\ &= (1.25)^5 \times 120 = \text{Rs. } 366.21 \end{aligned}$$

Hence, the correct option is (B).

2.41 (C)

Given :

The current population of a city = 11,02,500.

Since, successive $r\%$ increase of population for n years,

Since, present population = population before

$$\text{years} \times \left(1 + \frac{r}{100}\right)^n$$

$$\begin{aligned} \text{Population before 2 years} &\times \left(1 + \frac{5}{100}\right)^2 \\ &= 11,02,500 \end{aligned}$$

$$\begin{aligned} \text{Population before 2 years} &\times \frac{105}{100} \times \frac{105}{100} \\ &= 11,02,500 \end{aligned}$$

$$\text{Population before 2 years} \times \frac{105}{100} = 10500 \times 100$$

$$\text{Population before 2 years} = 100 \times 100 \times 100$$

Therefore, population before 2 years = 10,000,00

Hence, the correct option is (C).

2.42 (B)

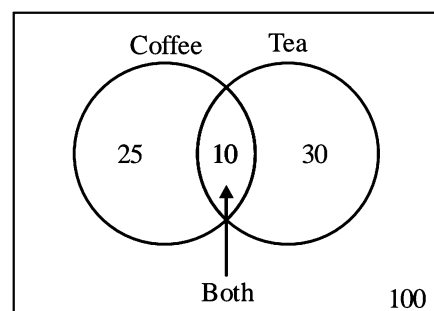
Given :

Employees drink coffee = 35%

Employees drink tea = 40%

Employees drink both tea and coffee = 10%

According to the given data, Venn diagram can be drawn as shown below



Employees who either drinks coffee or tea or both are, $25 + 10 + 30 = 65\%$

Employees who drink neither coffee nor tea are, $(100 - 65)\% = 35\%$

Hence, the correct option is (B).

2.43 (B)

Given :

In farm P ,

Number of Hens = 65

Number of Ducks = 91

Number of Goats = 169

In farm Q ,

Total number of Hens, Ducks and Goats = 416

The ratio of Hens, Ducks and Goats = 5:14:13

$$\text{Number of Hens} = 416 \times \frac{5}{32} = 65$$

$$\text{Number of Ducks} = 416 \times \frac{14}{32} = 182$$

$$\text{Number of Goats} = 416 \times \frac{13}{32} = 169$$

According to the condition given in the question,

$$\text{New number of Hens} = 65 + 65 = 130$$

$$\text{New number of Ducks} = 91 + 182 = 273$$

$$\text{New number of Goats} = 169 + 169 = 338$$

$$\text{Thus, the new ratio of Hens, Ducks and Goats} \\ = 10 : 21 : 26$$

Hence, the correct option is (B).

2.44 (D)

Given :

Ratio of Boys to Girls = 7 : 3

Total number of student in the class

$$= 7x + 3x$$

$$= 10x \text{ (here, } x \text{ must be an integer)}$$

$$= 50$$

(As only option (D) satisfies above condition)

Hence, the correct option is (D).

2.45 (C)

Given : Ratio of the cost price of P to $Q = 3 : 4$

$$\text{Cost of } P = 3x = 5400$$

$$x = 1800$$

$$\text{Cost of } Q = 4x = 7200$$

$$\text{Profit \% of } Q = 25\%$$

Selling price of

$$Q = 7200(\text{C.P.}) + 7200 \times 25\% (\text{Profit}) \\ = 9000$$

$$\text{Discount \%} = \frac{MP - SP}{MP} \times 100\%$$

$$\text{Discount \% for } Q = \frac{1000}{10000} \times 100\% = 10\%$$

Hence, the correct option is (C).

2.46 (D)

Given : The ratio of number of students of three classes

$$= 3x : 13x : 6x$$

After implementing the given condition,

$$3x + 18 = 15y \quad \dots(i)$$

$$13x + 18 = 35y \quad \dots(ii)$$

$$6x + 18 = 21y \quad \dots(iii)$$

Multiplying equation (i) by 2,

$$2 \times 3x + 18 \times 2 = 15y \times 2$$

$$6x + 36 = 30y \quad \dots(iv)$$

Subtract equation (iii) from (iv),

$$6x + 36 = 30y$$

$$- \quad 6x + 18 = 21y$$

$$18 = 9y$$

$$y = 2$$

By putting the value of y in equation (i), we get

$$3x + 18 = 15 \times 2$$

$$3x = 15 \times 2 - 18$$

$$3x = 12$$

$$x = 4$$

The total number students in all the three classes in the beginning

$$22x = 22 \times 4 = 88$$

Hence, the correct option is (D).

2.47 (B)

Given : $\frac{p}{q} = \frac{1}{2}$

$$\frac{q}{r} = \frac{4}{3}$$

$$\frac{r}{s} = \frac{4}{5}$$

Here, u is 50% is more than s

$$u = 150\% \text{ of } s$$

$$u = \frac{150}{100} s$$

$$\therefore \frac{u}{s} = \frac{3}{2}$$

Now, $\frac{p}{u} = \frac{p}{q} \times \frac{q}{r} \times \frac{r}{s} \times \frac{s}{u}$

$$\frac{p}{u} = \frac{1}{2} \times \frac{4}{3} \times \frac{4}{5} \times \frac{2}{3} = \frac{16}{45}$$

Hence, the correct option is (B).

2.48 (B)

Given : Capital of P = ~5000

Investment Time of P = 6 months

Investment Time of Q = 8 months

Profit sharing of Q = $\frac{4}{9}$

Profit sharing of 'P' = Capital of 'P'

× Investment Time of 'P'

Profit sharing of 'Q' = Capital of 'Q'

× Investment Time of 'Q'

$$\frac{30000}{8x} = \frac{5}{4}$$

$$x = \sim 3000$$

Hence, the correct option is (B).

2.49 (B)

Given : Let the total investment be x .

As we know that, $\frac{(\text{Profit})_1}{(\text{Profit})_2} = \frac{(\text{Investment})_1}{(\text{investment})_2} \times \frac{t_1}{t_2}$

	A	B	C
300x	400x	500x	1 st 6 month
330x	460x	600x	2 nd 6 month

$$\text{Net profit of A} = (300x + 330x) \times 6$$

$$\text{Net profit of B} = (400x + 460x) \times 6$$

$$\text{Net profit of C} = (500x + 600x) \times 6$$

$$A : B : C$$

$$630 : 860 : 1100$$

$$63 : 86 : 110$$

2.50 (A)

Let the value be k ,

Given : $x : y : z = \frac{1}{2} : \frac{1}{3} : \frac{1}{4}$

$$\therefore x = \frac{1}{2}k, y = \frac{1}{3}k, z = \frac{1}{4}k$$

Now, $\frac{x+z-y}{y} = \frac{\frac{1}{2}k + \frac{1}{4}k - \frac{1}{3}k}{\frac{1}{3}k}$

$$\frac{6k + 3k - 4k}{12} = \frac{k}{3}$$

$$\Rightarrow \frac{5k \times 3}{12k} = \frac{5}{4}$$

Hence, the correct option is (A).

2.51 (A)

Given : The average of monthly salaries M, N, S = Rs. 4000

$$\therefore \frac{M + N + S}{3} = 4000$$

$$M + N + S = 12000 \quad \dots(i)$$

The average of monthly salaries of N, S, P = Rs 5000

$$\therefore \frac{N + S + P}{3} = 5000$$

$$N + S + P = 15000 \quad \dots(ii)$$

Monthly salary of P = Rs. 6000

Put in equation (ii),

$$N + S + 6000 = 15000$$

$$N + S = 9000 \quad \dots(iii)$$

Now, from equation (i) and (iii),

$$M + N + S = 12000$$

$$M + 9000 = 12000$$

$$\therefore M = 3000 \text{ (Monthly salary of } M)$$

Monthly salary of M as a percentage of the monthly salary of P

$$= \frac{\text{Monthly salary of } M}{\text{Monthly salary of } P} \times 100$$

$$= \frac{3000}{6000} \times 100\% = 50\%$$

Hence, the correct option is (A).

2.52 (B)

Given : A survey for a certain year found that 90% of pregnant women received medical care at least once before giving birth of these women, 60% received medical from doctors.

With this given data option (A) can be inferred with certainty, as half of 90% will be 45% and from these 90%, 60% pregnant women received medical care from doctor, and 60% of 90% is 54% which is more than the percentage of half of pregnant women.

Hence, the correct option is (B).

2.53 (B)

Given : A recent survey shows that 65% of tobacco users were advised to stop consuming tobacco. The survey also shows that 3 out of 10 tobacco users attempted to stop using tobacco.

Option (C) cannot be inferred with certainty, as according to given information 3 out of 10 numerical tobacco users attempted to stop using tobacco, which is not a majority.

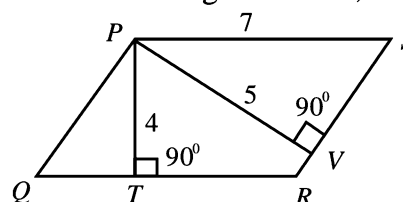
Option (A) and option (D) cannot be inferred with certainty, as there is no information about how much tobacco users successfully stop consuming tobacco.

Option (B) can be inferred with certainty, as 3 out of 10 tobacco users attempted to stop using tobacco; which means 7 users did not attempt to do this, and 7 out of 10 is a majority.

Hence, the correct option is (B).

2.54 (B)

Given : In the given figure, PQRS is a parallelogram with PS = 7 cm, PT = 4 cm and PV = 5 cm. What is the length of RS is,



In the given figure,

Let $\angle PQT$ and $\angle PSR$ are equal to θ .

$$\text{So, } \sin \theta = \frac{5}{7} = \frac{y}{x}$$

$$x = \frac{28}{5} \text{ cm}$$

Hence, the correct option is (B).

2.55 (A)

Given : To construct a wall, sand and cement are mixed in the ratio of 3:1. The cost of sand and that of cement are in the ratio of 1:2.

If the total cost of sand and cement to construct the wall is 1000 rupees, then the cost (in rupees) of cement used is,

Composition ratio of sand and cement is 3:1

Cost ratio of sand and cement is 1 : 2

Total cost of sand = Quantity $\times$ Cost

$$= 3x \times 1 = 3x$$

Total cost of cement = Quantity $\times$ Cost

$$= 1x \times 2 = 2x$$

Total cost of sand and cement = $3x + 2x = 5x$

According to the information, $5x = 1000$

$$x = 200$$

So, total cost of cement

$$= 2x = 2 \times 200 = 400 \text{ Rs.}$$

Hence, the correct option is (A).

2.56 (B)

Let the present age of Aman and his father is x and y years

Five year's ago, the ratio of Aman's and his father's age = $1 : 4$

$$\frac{x-5}{y-5} = \frac{1}{4}$$

$$4x - 20 = y - 5$$

$$4x - y = 15 \quad \dots(i)$$

Five year's from now, the ratio of ages = $2 : 5$

$$\frac{x+5}{y+5} = \frac{2}{5}$$

$$5x + 25 = 2y + 10$$

$$5x - 2y = 10 - 25$$

$$5x - 2y = -15 \quad \dots(ii)$$

Solving equation (i) and (ii),

$$x = 15 \text{ and } y = 45$$

Hence, the present age of Aman is 15 years and his father is 45 years.

Age of Aman's father when Aman was born = $45 - 15 = 30$ years

Hence, the correct option is (B).

2.57 (C)

As we know that :

$$\text{Profit} = \text{S.P} - \text{C.P}$$

$$\% \text{ Profit} = \frac{\text{S.P} - \text{C.P}}{\text{C.P}}$$

Given : Profit (%) = 20%

Let : C.P = x

$$0.2 = \frac{\text{S.P}}{\text{C.P}} - 1$$

$$\frac{\text{S.P}}{\text{C.P}} = 1.2$$

where, SP = Selling Price

CP = Cost Price

$$\frac{3186}{x + \frac{18x}{100}} = 1.2$$

$$\frac{3186}{1.18x} = 1.2$$

$$x = \frac{3186}{1.18 \times 1.2}$$

$$x = 2250$$

Hence the correct option is (C).

2.58 (A)

Given :

If for Non-zero real variable x , y and real parameter $a > 1$,

$$x : y = (a+1) : (a-1)$$

$$\frac{x}{y} = \frac{(a+1)}{(a-1)}$$

$$\frac{x^2 - y^2}{x^2 + y^2} = \frac{\left(\frac{x}{y}\right)^2 - 1}{\left(\frac{x}{y}\right)^2 + 1}$$

$$\frac{x^2 - y^2}{x^2 + y^2} = \frac{\left[\left(\frac{a+1}{a-1}\right)^2 - 1\right]}{\left[\left(\frac{a+1}{a-1}\right)^2 + 1\right]}$$

$$\frac{x^2 - y^2}{x^2 + y^2} = \frac{(a-1)^2 - (a-1)^2}{(a+1)^2 + (a-1)^2}$$

$$\frac{x^2 - y^2}{x^2 + y^2} = \frac{4a}{2a^2 + 2} = \frac{2a}{a^2 + 1}$$

Hence the correct option is (A).

2.59 (B)**Given :**

Total number of students (boys and girls) in classes VIII and IX is 450 and 360.

Number of girls in classes VIII and IX is the same.

Let the number of girls in class VIII and IX = x
then, number of boys in class VIII = $450 - x$

and number of boys in class IX = $360 - x$

According to question,

Ratio of number of girls to boys in class VIII is the same as the ratio of the number of boys to girls in class IX.

$$\text{i.e., } \frac{x}{450 - x} = \frac{360 - x}{x}$$

$$x^2 = (450 - x)(360 - x)$$

$$x^2 = 162000 - 450x - 360x + x^2$$

$$x(450 + 360) = 162000$$

$$x(810) = 162000$$

$$x = \frac{162000}{810}$$

$$x = 200$$

Hence, number of girls in each class is 200.

Hence, the correct option is (B).

2.60 (D)**Given :** Positive real numbers p and q

Percentage error in students answer = 80%

Actual answer of student = pq

Wrong answer of student = p/q

Percentage error in student's answer

$$= \frac{\text{Actual answer} - \text{Wrong answer}}{\text{Actual answer}} \times 100$$

$$= \frac{pq - p/q}{pq} \times 100$$

$$= \frac{q \left[p - \frac{p}{q^2} \right]}{pq} \times 100$$

$$= \frac{pq \left[1 - \frac{1}{q^2} \right]}{pq} \times 100$$

$$= \left(1 - \frac{1}{q^2} \right) \times 100 \quad \dots(i)$$

According to question,

Percentage error in student answer = 80%

$$\text{Hence, } 80 = \left(1 - \frac{1}{q^2} \right) \times 100$$

$$80 = \left(1 - \frac{1}{q^2} \right) \times 100$$

$$\frac{80}{100} = 1 - \frac{1}{q^2}$$

$$\frac{8}{10} = 1 - \frac{1}{q^2}$$

$$\frac{1}{q^2} = 1 - \frac{8}{10} = \frac{2}{10}$$

$$\frac{1}{q^2} = \frac{1}{5}$$

$$q^2 = 5$$

$$q = \sqrt{5}$$

Hence, the correct option is (D).

2.61 (C)

Given : No of coins of Rs 1, Rs 5 and Rs 10 denominations that a person has are in ratio 5 : 3 : 13

$$\text{i.e., } C_1 : C_5 : C_{10} = 5 : 3 : 13$$

where C_1, C_5, C_{10} are no. of coins of Rs 1, Rs 5, Rs 10 denominations

$$C_1 : C_5 : C_{10} = 5 : 3 : 13 = x(\text{let})$$

$$\text{i.e., } C_1 = 5x$$

$$C_5 = 3x$$

$$C_{10} = 13x$$

Amount of money in Rs 1 Coins

$$= 5x \times 1$$

$$= \text{Rs } 5x$$

Amount of money in Rs 5 Coins

$$= 3x \times 5$$

$$= \text{Rs } 15x$$

Amount of money in Rs 10 Coins

$$= 13x \times 10$$

$$= \text{Rs } 130x$$

Total amount of money that person has in Rs 1, Rs 5 and Rs 10 denomination

$$= 5x + 15x + 130x$$

$$= \text{Rs } 150x$$

$$= 150x \text{ Rs}$$

Percentage of money in Rs 5 coins

$$= \frac{15x}{150x} \times 100$$

$$= \frac{15}{150} \times 100$$

$$= 10\%$$

Hence, the correct option is (C).

2.62 (A)

Given : For positive non-zero real variables p and q

$$\log(p^2 + q^2) = \log p + \log q + 2\log 3$$

$$\log(p^2 + q^2) = \log p + \log q + \log 3^2$$

$$[\because n \log m = \log m^n]$$

$$\log(p^2 + q^2) = \log(pq) + \log 9$$

$$[\because \log m + \log n = \log mn]$$

$$\log(p^2 + q^2) - \log(pq) = \log 9$$

$$\log \left[\frac{p^2 + q^2}{pq} \right] = \log 9$$

$$\left[\because \log m - \log n = \log \left(\frac{m}{n} \right) \right]$$

Taking antilog both sides,

$$\frac{p^2 + q^2}{pq} = 9$$

$$\frac{p}{q} + \frac{q}{p} = 9 \quad \dots(i)$$

$$\text{Now, } \frac{p^4 + q^4}{p^2 q^2} = \frac{p^2}{q^2} + \frac{q^2}{p^2}$$

$$= \left(\frac{p}{q} \right)^2 + \left(\frac{q}{p} \right)^2$$

$$[\because a^2 + b^2 = (a+b)^2 - 2ab]$$

$$= \left(\frac{p}{q} + \frac{q}{p} \right)^2 - \frac{2p}{q} \frac{q}{p}$$

$$= \left(\frac{p}{q} + \frac{q}{p} \right)^2 - 2 \quad \dots(ii)$$

From equation (i)

$$\frac{p}{q} + \frac{q}{p} = 9$$

Substituting in equation (ii)

$$\frac{p^4 + q^4}{p^2 q^2} = (9)^2 - 2$$

$$\frac{p^4 + q^4}{p^2 q^2} = 81 - 2 = 79$$

Hence, the correct option is (A).

2.63 (C)

Common selling price = 's' each

one at profit = $p\%$

another at Loss = $p\%$

$$\text{then overall Loss\%} = \left(\frac{p^2}{100} \right) \%$$

here $p = 10$

$$\text{Loss \%} = \left(\frac{(10)^2}{100} \right) \% = 1\% \text{ Loss}$$

Hence, the correct option is (C).

2.64 (B)

Given : Frequency of $C = 130.8$ Hz

Ratio of frequencies of subsequent notes

$$= \sqrt[12]{2} = (2)^{\frac{1}{12}}$$

The 12 musical notes are given as,

$$C, C^\#, D, D^\#, E, F, F^\#, G, G^\#, A, A^\#.$$

First, count the number of half steps from C to $F^\#$

1. C to $C^\#$ (1 steps)
2. $C^\#$ to $D^\#$ (2 steps)
3. D to $D^\#$ (3 steps)
4. $D^\#$ to E (4 steps)
5. E to F (5 steps)
6. F to $F^\#$ (6 steps)

So, $F^\#$ is 6 half steps above C .

$\therefore$ The ratio of frequencies of note $F^\#$ and C is,

$$= \frac{130.8 \times \left[2^{\frac{1}{12}} \right]^6}{130.8} = 2^{\frac{1}{2}} = \sqrt{2}$$

Hence, the correct option is (B).

2.65 (B)

Let consultation fee = X

Case 1 : If $X \leq 5,00,000$

Overhead = 20% of $X = 0.2X$

Total cost = $X + 0.2X = 1.2X$

Tax = 18% of $1.2X = \left(\frac{18}{100} \right) \cdot (1.2X)$

Tax = $0.216X$

Total amount paid by client = $1.2X + 0.216X$
 $= 1.416X$

Given that, the client can only pay 10,00,000

$$1.416X = 10,00,000$$

$$X = 7,06,215$$

Case 2 : If $X > 500000$

Overhead = $1,00,000 + 10\% [X - 500000]$

Overhead = $1,00,000 + 0.1 [X - 500000]$

Total cost = $X + 1,00,000 + 0.1[X - 5,00,000]$

Total cost = $1.1X + 50000$

Tax = $\left(\frac{18}{100} \right) (1.1X + 50000)$

Tax = $0.198X + 9000$

Total amount paid by client

$$= 1.1X + 50000 + 0.198X + 9000$$

$$= 1.298X + 59000$$

Given that, the client can only

Pay 10,00,000

$$1.298X + 59000 = 10,00,000$$

$$X = 724,961$$

$\therefore$ Maximum consultation fee that the client can afford = 724961

Hence, the correct option is (B).

2.66 (B)

Scores obtained by two students P and Q in seven courses are given in the table

P	21	89	50	45	78	60	39
Q	35	65	60	56	81	45	50

From option (A) :

Average score of P ,

$$P_{avg} = \frac{22 + 89 + 50 + 45 + 78 + 60 + 39}{7}$$

$$= \frac{383}{7} = 54.71$$

Average score of Q ,

$$Q_{avg} = \frac{35 + 65 + 60 + 56 + 81 + 45 + 50}{7}$$

$$Q_{avg} = \frac{392}{7} = 56$$

i.e., $P_{avg} < Q_{avg}$

So, average score of P is less than the average score of Q .

Hence, the correct option is (A).

From option (B) :

Scores of P and Q in ascending order is

$P : 22, 39, 45, 50, 60, 78, 89$

$Q : 35, 45, 50, 56, 60, 65, 81$

Median is the middle term in the observation.

For odd observation if n is the total terms,

median is $\left(\frac{n+1}{2}\right)^{th}$ term.

Median score of P is 50.

Median score of Q is 56.

Hence, median score of P and Q are not same.

So, option (B) is not correct.

From option (C) :

Difference between maximum value and minimum value in observation is the range of observation.

Range of $P = 89 - 22 = 67$

Range of $Q = 81 - 35 = 46$

Hence, the difference between the maximum and minimum scores of P is greater than the difference between the maximum and minimum scores of Q .

So, option (C) is correct.

From option (D) :

Median score of Q is 56.

Average score of Q is 56.

Hence, median score and average score of Q are same.

So, option (D) is correct.

Hence, the incorrect option is (B).

2.67 (C)

Given : Sphere of unit diameter are centered at (l, m, n)

Distance between center of two adjacent sphere

$$= \sqrt{(l_2 - l_1)^2 + (m_2 - m_1)^2 + (n_2 - n_1)^2}$$

The nearest spheres are centered at $(r, 0, 0)$ or $(0, r, 0)$ or $(0, 0, r)$.

Distance to nearest sphere,

$$x = \sqrt{r^2 + 0^2 + 0^2}$$

$$x = r$$

The next nearest sphere lies diagonally when center differ by $(r, r, 0)$ or $(0, r, r)$, $(r, 0, r)$.

Distance to its next nearest sphere,

$$y = \sqrt{r^2 + r^2 + 0}$$

$$y = \sqrt{2} r$$

The value of $\frac{y}{x} = \frac{\sqrt{2} r}{r} = \sqrt{2}$

Hence, the correct option is (C).

2.68 (B)

Initially 40 W desk light is on for 10 hrs for 180 days

Total energy consumed = $40 \times 10 \times 180$
 $= 72000 \text{ Whr} = 72 \text{ kWhr [units]}$

Cost for 72 kWh = $72 \times 7 = \text{Rs } 504/-$

Extra energy consumed when the light is ON for 2 hrs more

$$= 2 \times 180 \times 40 = 14400 \text{ Whr} = 14.4 \text{ Whr}$$

Additional cost = $14.4 \times 7 = \text{Rs } 100.8/-$

Percentage increase in cost = $\frac{100.8}{504} \times 100 = 20\%$

Hence, the correct option is (B).

2.69 (C)

Given : Average marks obtained by a class in an examination = 30.8

Incorrect marks = 24, Correct marks = 42

Average marks after connection = 31.4

Let the total number of students in class = n

Average = $\frac{\text{Total original marks}}{\text{Total number of students in class}}$

Total original marks = $30.8 \times n$

One student's marks were recorded as 24 instead of 42.

Error in the result = $42 - 24 = 18$ marks

Total correct marks after correction of error
= $30.8n + 18$

New average after correction = 31.4

Total correct marks after correction = $31.4 \times n$

According to question :

$$30.8n + 18 = 31.4n$$

$$18 = 31.4n - 30.8n$$

$$18 = 0.6n$$

$$n = \frac{18}{0.6}$$

$$n = 30$$

Thus, the class has 30 students.

Hence, the correct options is (C).

2.70 (A)

Given : QR and ST are parallel to each other.

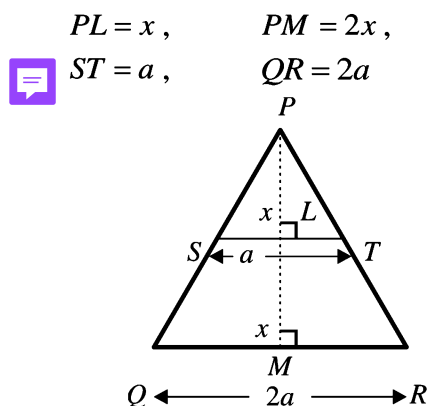
Shortest distance between QR and ST is half of shortest distance between the point P and line QR .

Let the shortest between QR and ST in x .

According to question,

Shortest distance between P and line $QR = 2x$.

From figure :



$$\text{Area of } \triangle PST = \frac{1}{2} \times \text{Base} \times \text{Height}$$

$$= \frac{1}{2} \times x \times a = \frac{xa}{2}$$

Area of trapezium STQR

$$= \frac{1}{2} [\text{Sum of parallel sides}] \times \text{Height}$$

$$= \frac{1}{2} [a + 2a][x] = \frac{3a}{2} x$$

Ratio of area of triangle PST to area of trapezium SQR

$$\frac{\Delta PST}{\text{Trap } SQR} = \frac{\frac{xa}{2}}{\frac{3ax}{2}}$$

$$\frac{\Delta PST}{\text{Trap } SQR} = \frac{1}{3}$$

Hence, the correct option is (A).

2.71 (B)

Given : The weight function is given as monotonically increasing until age 50 and monotonically decreasing afterward.

This means the maximum weight occurs at age 50.

Since, both brothers follow the same function, they will attain the same weight at two different ages: one before 50 and one after 50.

That is, for one brother,

$$a_1 < 50, \text{ and for the other,}$$

$$a_2 > 50$$

Hence, the correct option is (B).

2.72 (B)

$$\log_{p^{1/n}} y \times \log_{y^{1/n}} p = 16$$

$$\frac{\log y}{\frac{1}{n} \log p} \times \frac{\log p}{\frac{1}{n} \log y} = 16$$

$$\frac{1}{1/n^2} = 16$$

$$n^2 = 16 \Rightarrow n = 4$$

Hence, the correct option is (B).

2.73 (C)

$$P_1 = 4$$

$$P_2 = 8$$

$$P_3 = 12$$

$$P_1 + P_2 + P_3 + \dots + P_{10} = 4 + 8 + 12 + \dots + 40$$

$$= 4(1 + 2 + 3 + \dots + 10)$$

$$= 4 \times \frac{10 \times 11}{2} = 220$$

Hence, the correct option is (C).

2.74 (A)

Curves:

$$y = x^2$$

$$y = -x^2 - 2x - 1$$

At intersection:

$$x^2 = -x^2 - 2x - 1$$

Bring all terms together:

$$2x^2 + 2x + 1 = 0$$

Discriminant:

$$D = b^2 - 4ac$$

$$D = (2)^2 - 4(2)(1)$$

$$D = 4 - 8$$

$$D = -4$$

Since, $D < 0$ there are no real solutions.

Thus the curves do not intersect in the real plane.

Hence, the correct option is (A).

2.75 (A)

$$\log_2^x + \log_{\sqrt{2}} x = 48$$

$$\log_2^x + \frac{\log_2 x}{\log_2 \sqrt{2}} = 48$$

$$\log_2 x + \frac{\log_2 x}{\log_2 \sqrt{2}} = 48 \quad \left[\log_b a = \frac{\log_k a}{\log_k b} \right]$$

$$\log_2 x + \frac{\log_2 x}{\frac{1}{2}} = 48$$

$$\log_2^x + 2 \log_2 x = 48$$

$$3 \log_2 x = 48$$

$$\log_2 x = 16$$

$$x = 2^{16}$$

Hence, the correct option is (A).

2.76 (B)

Step 1 : Define variables

Let x be the quantity of product T sold. Based on the observations :

- **Quantity of T :** x
- **Quantity of S :** $2x$ (twice that of T)
- **Quantity of R :** $3x$ (thrice that of T)
- **Quantity of Q :** $4x$ (four that of T)
- **Quantity of P :** Let this be y .

Step 2 : Use total quantity to relate x and y

The total number of items sold is 250.

$$P + Q + R + S + T = 250$$

$$y + 4x + 3x + 2x + x = 250$$

$$y + 10x = 250 \Rightarrow y = 250 - 10x \dots (i)$$

Step 3 : Use Average Selling Price for Total Revenue

Total Revenue = Total Quantity $\times$ Average Selling Price

$$\text{Total Revenue} = 250 \times 60 = 15000 \text{ Rs.}$$

Now, calculate revenue per product using the unit prices from the table :

- **Rev from P :** $100y$
- **Rev from Q :** $50(4x) = 200x$

- **Rev from R :** $40(3x) = 120x$
- **Rev from S :** $60(2x) = 120x$
- **Rev from T :** $60(x) = 60x$

Summing these up :

$$\begin{array}{r} 1 \quad 0 + 0 \quad x \quad 2 \quad 0 \quad 0 + \quad 1 \quad x \quad 2 \quad 0 \\ 1 \quad 0 + 0 \quad x \quad 5 \quad 0 \quad 0 \Rightarrow y \quad 1 \quad 5 \\ \dots(ii) \end{array}$$

Step 4 : Solve the Equations

Substitute Equation 1 into Equation 2 :

$$(250 - 10x) + 5x = 150$$

$$250 - 5x = 150$$

$$5x = 100 \Rightarrow x = 20$$

Now, find y (Quantity of P) :

$$y = 250 - 10(20)$$

$$y = 250 - 200$$

$$y = 50$$

Hence, the correct option is (B).

2.77 (D)

Given:

2 June = Thursday

Number of days from 2 June $\rightarrow$ 3 July

June remaining days:

$$30 - 2 = 28$$

Add 3 days of July

$$28 + 3 = 31 \text{ days}$$

Now,

$$31 \bmod 7 = 3$$

Day shift = 3 days

Thursday + 3 days:

Friday - Saturday - Sunday

Hence, the correct option is (D).

2.78 (A)

Stock of B

$$80 / 80 = 1 \text{ stock}$$

$$\text{Total cost price} = 180$$

$$\begin{aligned} \text{Total selling price (S.P)} &= 2 \times 55 + 70 \times 1 \\ &= 110 + 70 = 180 \end{aligned}$$

$$\begin{aligned} \text{Profit} &= \text{S.P} - \text{C.P} \\ &= 180 - 180 = 0 \end{aligned}$$

Hence, the correct option is (A).

2.79 (B)

Let the five integers in sorted order be

$$a_1 \leq a_2 \leq a_3 \leq a_4 \leq a_5$$

1. Mean = 12

$$a_1 \leq a_2 \leq a_3 \leq a_4 \leq a_5$$

2. Median = 18

$$a_3 = 18$$

3. Single mode = 20

So 20 must appear most frequently.

Since numbers are ordered and $a_3 = 18$:

$$a_4, a_5 \geq 18$$

To make 20 the unique mode, the only possibility is

$$a_4 = 20, a_5 = 20$$

4. Sum condition :

$$a_1 + a_2 + 18 + 20 + 20 = 60$$

$$a_1 + a_2 = 2$$

With $a_1 \leq a_2 \leq 18$ and integers 0-20 :

Possible pairs :

- (0, 2)
- (1, 1)

But (1, 1) gives two modes (1 and 20), so mode is not unique.

Thus only valid set :

$$(0, 2, 18, 20, 20)$$

Hence, the correct option is (B).

Engineering Services Examination (ESE)**1. (D)**

Given : Passengers in each white car = 6
 Passengers in each silver car = 5
 Passengers in each black car = 3
 Number of white and silver cars are equal.
 Let, the number of white and silver cars be x .

According to the question,

Number of passengers in white car = $6x$
 Number of passengers in black car = only 3

Therefore, $6x + 5x + 3 = 300$

$$11x = 297$$

$$x = 27$$

Therefore, total number of cars are :

Total white cars + Total silver cars
 + Total black cars = Total cars
 $27 + 27 + 1 = 55$

Hence, the correct option is (D).

2. (A)

Given :

The ratio of present ages of 3 brothers = 3 : 4 : 5

Let, x be the common multiple, $3x : 4x : 5x$

Then after 10 years the sum of their ages :

$$(3x + 10) + (4x + 10) + (5x + 10) = 78$$

$$12x = 48$$

$$x = 4$$

By putting the value of x , we get

$$3x : 3 \times 4 = 12$$

$$4x : 4 \times 4 = 16$$

$$5x : 5 \times 4 = 20$$

Hence, the correct option is (A).

3. (C)

Given : Total number of notes = 324

Let, Number of Rs.20 notes be x ,

Number of Rs.50 notes be y ,

According to the question,

$$x + y = 324 \quad \dots(i)$$

$$20x + 50y = 12450 \quad \dots(ii)$$

From equation (i) and (ii)

$$50x + 50y = 16200$$

$$20x + 50y = 12450$$

$$30x = 3750$$

$$x = 125$$

Thus, the number of Rs.20 notes are 125.

Hence, the correct option is (C).

4. (C)

Given :

Saving of Rajiv at the month end = Rs.2000

Expenditure on Food = 40% of salary

Expenditure on House rent = 20% of salary

Expenditure on Conveyance = 10% of salary

Expenditure on Entertainment = 10% of salary

Thus, Total expenditure = 80% of salary

Let, the salary of Rajiv be x ,

Here, Saving = $x - 80\%$ of x

$$2000 = x - 0.8x$$

$$x = \frac{2000}{0.2}$$

$$x = 10000$$

Thus, the monthly salary of Rajiv is Rs.10,000.

Hence, the correct option is (C).

5. (C)

Given : Total selling price in the first condition

$$= \text{Rs.}7,600$$

Total selling price in the second condition

$$= \text{Rs.}7,500$$

According to the question,

$$(\text{Chair} \times 125\%) + (\text{Table} \times 110\%) = \text{Rs.}7600 \quad \dots(i)$$

$$(\text{Chair} \times 110\%) + (\text{Table} \times 120\%) = \text{Rs.}7500 \quad \dots(ii)$$

From equation (i) and (ii),

$$\text{Chair} \times 15\% - \text{Table} \times 10\% = \text{Rs.}100 \quad \dots(iii)$$

Apply equation (i) $\times 12$

$$\text{Chair} \times 180\% - \text{Table} \times 120\% = \text{Rs.}1200 \dots (\text{iv})$$

Add equation (ii) & (iv),

$$\text{Chair} \times 110\% + \text{Table} \times 120\% = \text{Rs.}7500$$

$$+ \text{Chair} \times 180\% - \text{Table} \times 120\% = \text{Rs.}1200$$

$$\text{Chair} \times 290\% = \text{Rs.}8700$$

$$\text{Chair} = \frac{8700}{290} \times 100 = \text{Rs.}3000$$

From equation (iii),

$$\text{Rs.}3000 \times 15\% - \text{Rs.}100 = \text{Table} \times 100\%$$

$$\text{Rs.}(450 - 100) = \text{Table} \times 10\%$$

$$\text{Table} = \frac{350}{10} \times 100 = \text{Rs.}3500$$

Thus, the cost price of chair and table
= 3000 and 3500.

Hence, the correct option is (C).

6. (B)

Given :

Total cost of books = Rs.1600

Let, The total number of books = x

$$\text{Thus, cost of '1' book} = \text{Rs.} \frac{1600}{x} \dots (\text{i})$$

According to the question,

The new number of books = $(x + 8)$

$$\text{New cost of 1 book} = \text{Rs.} \frac{1600}{(x+8)} \dots (\text{ii})$$

From equation (i) and (ii),

$$\text{Rs.} \frac{1600}{x} - \text{Rs.} \frac{1600}{(x+8)} = \text{Rs.}10$$

$$\frac{1}{x} - \frac{1}{(x+8)} = \frac{1}{160}$$

$$\frac{x+8-x}{x(x+8)} = \frac{1}{160}$$

$$\frac{8}{x(x+8)} = \frac{1}{160}$$

$$x(x+8) = 1280$$

$$x^2 + 8x - 1280 = 0$$

$$x^2 + 40x - 32x - 1280 = 0$$

$$x(x+40) - 32(x+40) = 0$$

$$x = 32, -40$$

Thus, number of books he buys = 32 (Answer must be positive)

Hence, the correct option is (B).

7. (A)

Given :

Length of rod = l

Length of smaller portion = x

So, Length of larger portion = $(l - x)$

According to the question,

$$5x + \frac{1}{2}(l - x) < l$$

$$x < \frac{l}{9}$$

Thus, length of larger portion $> l - \frac{l}{9} = \frac{8l}{9}$

Most appropriate answer is option (A).

Hence, the correct option is (A).

8. (B)

Given :

1st Quarter Compound Interest Rate % = 3%

2nd Quarter Compound Interest Rate % = 3%

3rd Quarter Compound Interest Rate % = 3%

4th Quarter Compound Interest Rate % = 3%

In case of compounded quarterly,

Rate becomes $\frac{1}{4}$ for every quarter.

Effective rate for first two quarters is,

$$\begin{aligned} (x, y)\% &= x\% + y\% + \frac{xy}{100}\% \\ &= (6 + 0.09)\% \end{aligned}$$

Similarly,

Effective rate for last two quarters = 6.09%

Thus, effective rate for first two and last two quarters,

$$\begin{aligned} 6.09\%, 6.09\% &= 6.09\% + 6.09\% + \frac{37.09}{100}\% \\ &= 12.18\% + 0.38\% \\ &= \mathbf{12.6\%} \text{ (approx)} \end{aligned}$$

The effective rate of interest per annum is nearly 12.6%.

Hence, the correct option is (B).

9. (B)

Given : $A = \text{Rs } 926.10$

$$P = \text{Rs } 800$$

$$A = P \left(1 + \frac{r}{100} \right)^n$$

$$926.10 = 800 \left(1 + \frac{5}{100} \right)^n$$

Interest become half because half yearly 10% per annum 5% per 6 month.

$$\frac{926.10}{800} = \left(1 + \frac{5}{100} \right)^n$$

After Simplification,

$$n = \frac{3}{2} \text{ (or) } 1\frac{1}{2} \text{ year.}$$

Hence, the correct option is (B).

10. (D)

Given : The population of a village is 5500

Number of males increases by 11%

Number of females increases by 20%

Final population = 6330

Let the population of females in the village be z

Now According to the Question

Number of males in the village $(5500 - x)$

$$(5500 - x) \times 1.11 + (x) \times 1.2 = 6330$$

$$6105 - 1.11x + 1.2x = 6330$$

$$0.09x = 225$$

$$x = 2500$$

Hence, the correct option is (D).

11. (B)

Given :

- Rohith spends 40% of his monthly income on food items and 50% of the remaining on clothes and conveyance.
 - He saves one-third of remaining amount after spending on food, clothes and conveyance.
 - He saves Rs. 19,200 every year
- Food items = 40%
Clothes + Conveyance = 50% of 60%
Clothes + Conveyance = 30%
Remaining = $(100 - 40 - 30)\% = 30\%$

$$= \frac{1}{3} \times (30\%) = 19200$$

$$10\% = 19200$$

$$100\% = 192000$$

$$\text{Monthly Income} = \frac{192000}{12} = \text{Rs. } 16000$$

Hence, the correct option is (B).

12. (B)

Given :

$$(i) \quad CI - SI = 16$$

$\therefore$ **Compound Interest**

$$CI = P \left(1 + \frac{R}{100} \right)^n - P$$

$\therefore$ **Simple Interest**

$$SI = \frac{PRT}{100}$$

$$\text{Now, } P \left(1 + \frac{R}{100} \right)^n - P - \frac{PRT}{100} = 16$$

Rate of Interest (R) = 8%

$$P \left[1 + \frac{8}{100} \right]^2 - P - \frac{P \times 8 \times 2}{100} = 16$$

$$P \left(\frac{108}{100} \right)^2 - P - \frac{16P}{100} = 16$$

$$P \left[\left(\frac{108}{100} \right)^2 - 1 - \frac{16}{100} \right] = 16$$

$$P \left[\left(\frac{27}{25} \right)^2 - 1 - \frac{16}{100} \right] = 16$$

$$P = 2500$$

Now if the interest were compounded half yearly.

$$= CI - SI$$

$$= P \left[1 + \frac{R/2}{100} \right]^{2n} - P - SI$$

$$= P \left[1 + \frac{4}{100} \right]^{2 \times 2} - P - \frac{P \times 8 \times 2}{100}$$

$$= P \left[\left(\frac{26}{25} \right)^4 - 1 - \frac{16}{100} \right]$$

$$= 2500 \left[\left(\frac{26}{25} \right)^4 - 1 - \frac{16}{100} \right] = 24.64$$

Hence, the correct option is (B).

13. (B)

Let weight 1 mango = m grams and weight of 1 apple = a grams

$$3m + 2a = 255$$

$$2m + 3a = 285$$

Solving equation (i) and (ii), we get

$$a = 69, m = 39$$

$$a + m = 108$$

Hence, the correct option is (C).

14. (B)

let total marks = T

$$\text{Passing marks} = T \times \frac{20}{100} + 30 = 0.2T + 30$$

According to question

$$\text{Passing mark} + \frac{42}{100} \times \text{Passing mark} = T \times \frac{32}{100}$$

$$0.2T + 30 = \frac{32}{142}T = 0.225T$$

Passing percentage = 22.5%.

Hence, the correct option is (A).

15. (B)

$$\text{Value after 3 years} = 100000 \times \left(1 - \frac{5}{100} \right)^3$$

$$= 100000 \times \left(\frac{95}{100} \right)^3 \approx 85738$$

Hence, the correct option is (D).

16. (B)

Let monthly salary = Rs. x

$$\text{Groceries expense} = \frac{2}{5}x$$

Remaining salary

$$x - \frac{2}{5}x = \frac{3}{5}x$$

He spends $\frac{3}{10}$ of the remaining on clothes.

Clothes expense

$$\frac{3}{10} \times \frac{3}{5}x = \frac{9}{50}x$$

Therefore savings

$$x - \frac{2}{5}x - \frac{9}{50}x$$

$$= x - \frac{20}{50}x - \frac{9}{50}x$$

$$= \frac{21}{50}x$$

Given savings = Rs. 10,500

$$\frac{21}{50}x = 10500$$

$$x = 10500 \times \frac{50}{21}$$

$$x = 25000$$

Monthly salary = 25,000

Hence the correct option is (D).

17. (B)

For many alloy systems and at some specific temperature, there is a maximum concentration of solute atoms that may dissolve in the solvent to form a solid solution; this is called a solubility limit. The addition of solute in excess of this solubility limit results in the formation of another solid solution or compound that has a distinctly different composition.

Hence, the correct option is (D).

18. (B)

Square side = 6 cm

- Inscribed circle radius :

$$r_1 = \frac{6}{2} = 3$$

Area of inscribed circle :

$$A_1 = \pi r_1^2 = \pi(3)^2 = 9\pi$$

- Circumscribed circle radius = half of diagonal

Diagonal of square :

$$d = 6\sqrt{2}$$

So,

$$r_2 = \frac{6\sqrt{2}}{2} = 3\sqrt{2}$$

Area of circumscribed circle :

$$A_2 = \pi(3\sqrt{2})^2 = 18\pi$$

Thus,

$$A_1 : A_2 = 9\pi : 18\pi = 1 : 2$$

Hence, the correct option is (D).



3

Mixture Alligation & Direction

A. MIXTURES AND ALLIGATION :

In Alligation (mixing), we will deal with problems related to mixing of different compounds or quantities. The concept of alligation and weighted average are the same.

When two or more quantities are mixed together in different ratios to form a mixture, then ratio of the quantities of the two constituents is given by the following formula,

$$\frac{Q_c}{Q_d} = \frac{d - m}{m - c}$$

Where, d = cost price of quantity D, c = cost price of quantity C, m = mean price of mixture.

In the alligation rule, the variables c , d and m may be expressed in terms of percentage (e.g. A 20 % mixture of salt in water), fractions (e.g. two- fifth of the solution contains salt) or proportions (e.g. A solution of milk and water is such that milk: Water = 2 : 3). The important point is to remember is that c and d may represent pure ingredients or mixtures.

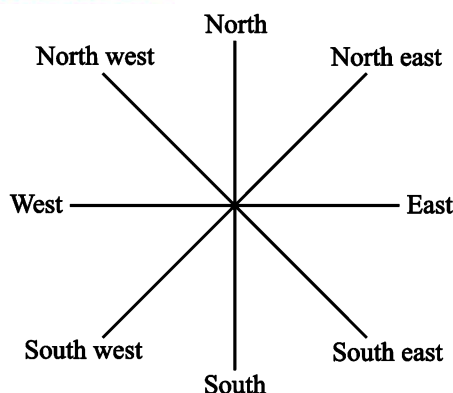
Removal and Replacement

If a vessel contains “ x ” litres of milk and if “ y ” litres be withdrawn and replaced by water and the operation is repeated ‘ n ’ times in all then,

$$\frac{\text{Milk left in vessel after } n^{\text{th}} \text{ operation}}{\text{Initial quantity of milk in vessel}} = \left[\frac{x - y}{x} \right]^n = \left[1 - \frac{y}{x} \right]^n$$

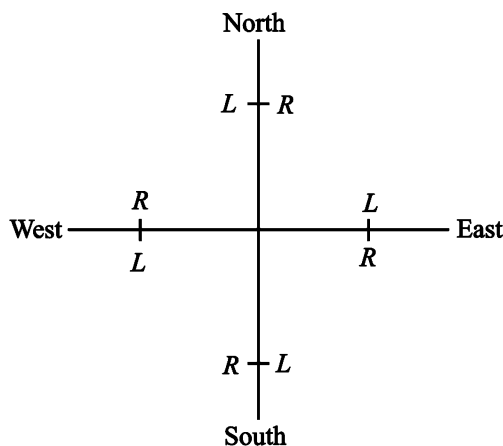
B. DIRECTIONS :

1. Standard diagram of directions :

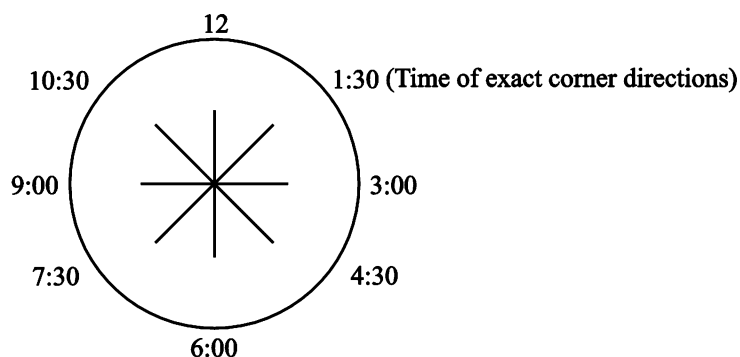


Corner directions are given as NE, NW, SE, SW.

2. LR diagram :



3. Clock directions :

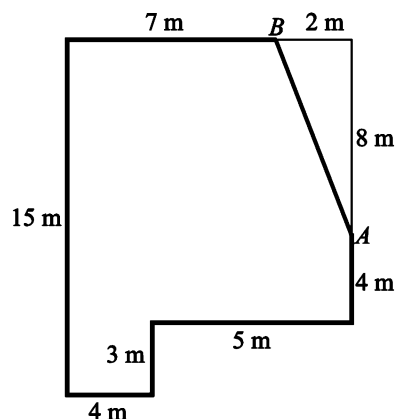


Example 1

Kajal started from point A in south direction. After walking for 4 m she turned to her right and walked 5 m. Now she turned to her left and walked 3 m after which she turned to her right. Now she walked 4 m and turned to her right again and walked 15 m. Now finally she turned to her right and after walking for 7 m, she stopped at point B. What is the distance AB?

Solution :

Given :



By Pythagoras's theorem,

$$X^2 = 8^2 + 7^2$$

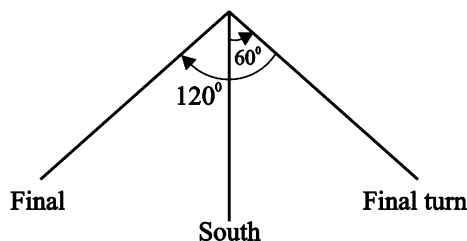
$$X = \sqrt{68} = 2\sqrt{17}$$

Example 2

A boy is facing south direction. He turns 60 degree in anti-clockwise direction and then 120 degree in clockwise direction. In which direction is the facing?

Solution :

South west

**2010 IIT Guwahati**

3.1 A tank has 100 litres of water. At the end of every hour the following two operations are performed in sequence;

- (i) Water equal to $m\%$ of the current contents of the tank is added to the tank.
- (ii) Water equal to $n\%$ of the current contents of the tank is removed from the tank.

At the end of 5 hours the tank contains exactly 100 litres of water. The relation between m and n is : **[TF]**

- (A) $m = n$
- (B) $m > n$
- (C) $m < n$
- (D) None of the previous

2011 IIT Madras

3.2 A container originally contains 10 litres of pure spirit. From this container 1 litre of spirit is replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this process is repeated one more time.

How much spirit is now left in the container?

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) 7.58 litres
- (B) 7.84 litres
- (C) 7 litres
- (D) 7.29 litres

2014 IIT Kharagpur

3.3 X is 1 km North-East of Y. Y is 1 km South-East of Z. W is 1 km West of Z. P is 1 km South of W. Q is 1 km East of P. What is the distance between X and Q in km. **[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]**

- (A) 1
- (B) $\sqrt{2}$
- (C) $\sqrt{3}$
- (D) 2

3.4 It takes 30 minutes to empty a half-full tank by draining it at a constant rate. It is decided to simultaneously pump water into the half-full tank while draining it. What is the rate at which water has to be pumped in so that it gets fully filled in 10 minutes? **[EC-2, ME-2]**

- (A) 4 times the draining rate.
- (B) 3 times the draining rate.
- (C) 2.5 times the draining rate.
- (D) 2 times the draining rate.

2015 IIT Kanpur

- 3.5** Mr. Vivek walks 6 meters North-East, then turns and walks 6 meters South-East, both at 60 degrees to East. He further moves 2 meters South and 4 meters West. What is the straight distance in meters between the point he started from and the point he finally reached? [CE-2]
- (A) $2\sqrt{2}$ (B) 2
(C) $\sqrt{2}$ (D) $1/\sqrt{2}$

2016 IISc Bangalore

- 3.6** *M* and *N* start from the same location. *M* travels 10 km East and then 10 km North-East. *N* travels 5 km South and then 4 km South-East. What is the shortest distance (in km) between *M* and *N* at the end of their travel? [EC-2, ME-3]
- (A) 18.60 (B) 22.50
(C) 20.61 (D) 25.00

2017 IIT Roorkee

- 3.7** Fatima starts from point *P*, goes North for 3 km and then East for 4 km to reach point *Q*. She then turns to face point *P* and goes 15 km in that direction. She then goes North for 6 km. How far is she from point *P*, and in which direction should she go to reach point *P*? [AE, EC-2, MA, MT, PE, PH]
- (A) 8 km, East (B) 12 km, North
(C) 6 km, East (D) 10 km, North
- 3.8** There are five buildings called *V*, *W*, *X*, *Y* and *Z* in a row (not necessarily in that order). *V* is to the West of *W*, *Z* is to the East of *X* and the West of *V*, *W* is to the West of *Y*. Which is the building in the middle? [CS-2, EE-2]

- (A) *V* (B) *W*
(C) *X* (D) *Y*

2021 IIT Bombay

- 3.9** On a planer field, you travelled 3 units East from a point *O*. Next you travelled 4 units South to arrive at point *P*. Then you travelled from *P* in North-East direction such that you arrive at a point that is 6 units East of point *O*. Next, you travelled in the North-West direction, so that you arrive at point *Q* that is 8 units North of point *P*. The distance of point *Q* to point *O*, in same units, should be _____.

[AE, AR, BM, CE-2, MN, PH]

- (A) 6 (B) 4
(C) 5 (D) 3

- 3.10** Ms. *X* came out of a building through its front door to find her shadow due to the morning sun falling to her right side with the building to her back. From this, it can be inferred that building is facing _____

[ME-1, XH]

- (A) North (B) East
(C) West (D) South

- 3.11** The front door of Mr. *X*'s house faces East. Mr. *X* leaves the house, walking 50 m straight from the back door that is situated directly opposite to the front door. He then turns to his right, walks for another 50 m and stops. The direction of the point Mr. *X* is now located at with respect to the starting point is _____

[ME-2, MT]

- (A) North-West (B) North-East
(C) South-East (D) West

2022 IIT Kharagpur

- 3.12** The price of an item is 10% cheaper in an online store S compared to the price at another online store M. Store S charges Rs.150 for delivery. There are no delivery charges for orders from the store M. A person bought the item from the store S and saved Rs.100.

What is the price of the item at the online store S (in Rs.) if there are no other charges than what is described above?

[EE]

- (A) 1500 (B) 2500
(C) 1750 (D) 2250

- 3.13** A sum of money is to be distributed among P, Q, R and S in the proportion 5 : 2 : 4 : 3, respectively.

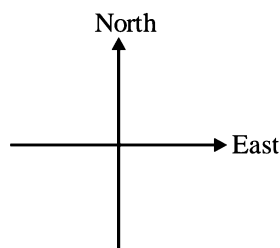
If R get ₹1000 more than S, what is the share of Q (in ₹)?

[ECE]

- (A) 1000 (B) 1500
(C) 2000 (D) 500

- 3.14** An ant walks in a straight line on a plane leaving behind a trace of its movement. The initial position of the ant is at point P facing east. The ant first turns 72° anticlockwise at P, and then does the following two steps in sequence exactly five times before halting.

1. Moves forward for 10 cm
2. turns 144° clockwise



The pattern made by the trace left behind by the ant is.

[CE-2]

- (A) PQ = QR = RS = ST

$= TU = UP = 10 \text{ cm}$

- (B) SW = WR = RP = PT = TQ = QU = US = 10 cm

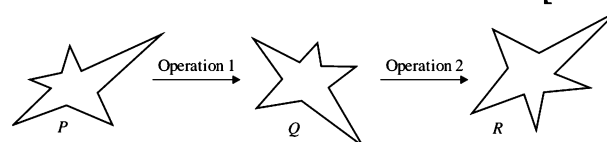
- (C) PQ = QR = RS = ST = TP = 10 cm

- (D) SQ = QT = TR = RP = PS = 10 cm

2023 IIT Kanpur

- 3.15** Which one of the options best describes the transformation of the 2-dimensional figure P to Q, and then to R as shown?

[CSE]



- (A) **Operation 1** : A clockwise rotation by 90° about an axis perpendicular to the plane of the figure.
Operation 2 : A reflection along a vertical line.
- (B) **Operation 1** : A clockwise rotation by 90° about an axis perpendicular to the plane of the figure.

Operation 2 : A reflection along a horizontal line.

(C) **Operation 1 :** A counter clockwise rotation by 90° about an axis perpendicular to the plane of the figure.

Operation 2 : A reflection along a horizontal line.

(D) **Operation 1 :** A counter clockwise rotation by 180° about an axis perpendicular to the plane of the figure.

Operation 2 : A reflection along a vertical line.

- 3.16** Consider a spherical globe rotating about an axis passing through its poles. There are three points P , Q , and R situated respectively on the equator, the north pole, and midway between the equator and the north pole in the northern hemisphere. Let P , Q , and R move with speeds v_P , v_Q , and v_R , respectively.

Which one of the following options is CORRECT?

[CE-2]

- (A) $v_P < v_R < v_Q$ (B) $v_P < v_Q < v_R$
(C) $v_P > v_R > v_Q$ (D) $v_P = v_R \neq v_Q$

2024 IISc Bangalore

- 3.17** During a half-moon phase, the Earth-Moon-Sun form a right triangle. If the Moon-Earth-Sun angle at this half-moon phase is measured to be 89.85° , the ratio of the Earth-Sun and Earth-Moon distances is closest to

- (A) 328 (B) 382
(C) 238 (D) 283

[CE-1, CH]

2025 IIT Roorkee

- 3.18** A business person buys potatoes of two different varieties P and Q, mixes them in a certain ratio and sells them at . 192 per kg.

The cost of the variety P is . 800 for 5 kg.

The cost of the variety Q is . 800 for 4 kg.

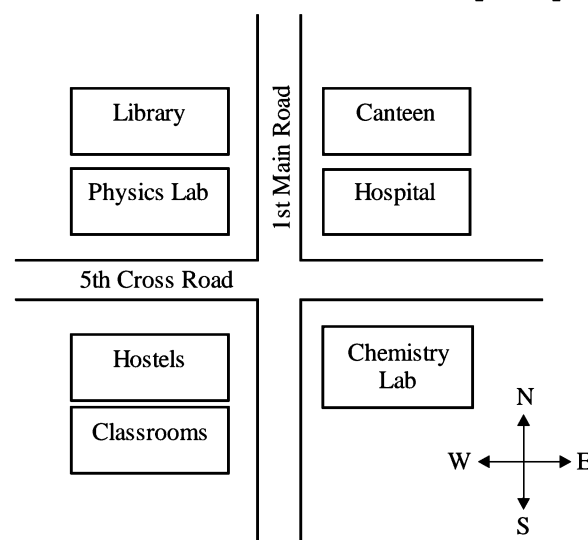
If the person gets 8% profit, what is the P : Q ratio (by weight)? [CE-2, XE]

- (A) 5 : 4 (B) 3 : 4
(C) 3 : 2 (D) 1 : 1

- 3.19** According to the map shown in the figure, which one of the following statements is correct?

Note: The figure shown is representative.

[CS-1]



- (A) The library is located to the northwest of the canteen.
(B) The hospital is located to the east of the chemistry lab.
(C) The chemistry lab is to the southeast of physics lab.
(D) The classrooms and canteen are next to each other.

2026 IIT Guwahati

- 3.20** Four hills H1, H2, H3, and H4 are present in an area. The following observations are made about them:
- Neither H2 nor H3 is the easternmost hill.
 - Neither H2 nor H3 is the westernmost hill.
 - Neither the easternmost hill nor the westernmost hill is the southernmost hill.
 - Two hills are located to the west of H2.
 - The southernmost hill has at least two hills to its east.

The southernmost hill is _____. [CH]

- (A) H1 (B) H2
(C) H3 (D) H4

Engineering Services Examination (ESE)

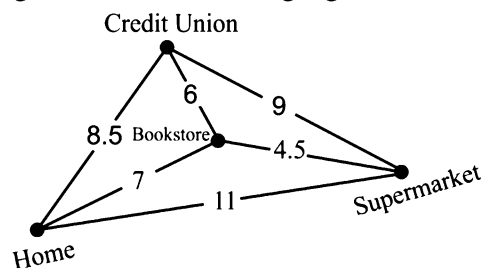
- A man walked 3 km towards East, then 5 km towards North-East, then 8 km towards South and finally 5 km towards North-East direction. The distance of his present location from the starting point will be :
(A) 9 km (B) 11 km
(C) 15 km (D) 21 km
- A man walks 1 km to East and then he turns to South and walks 5 km. Again, he turns to East and walks 2 km. After, he turns to North and walks 9 km. Now, how far he is from his station point ?
(A) 3 km (B) 4 km
(C) 5 km (D) 7 km

[ESE 2021]

- Rohith went 15 km to the west from his house then he turned left and walked 25 km. He then turned east and walked 25 km and finally turning left covered 20 km. How far is he from his house?
(A) 5 km (B) 10 km
(C) 40 km (D) 80 km

[ESE 2023]

- You need to buy groceries at the supermarket, deposit a cheque at the credit union, and purchase a book at the bookstore. You can complete the errands in any order; however, you must start and end at your home. The driving time, in minutes, between each of these locations is given in the following figure.

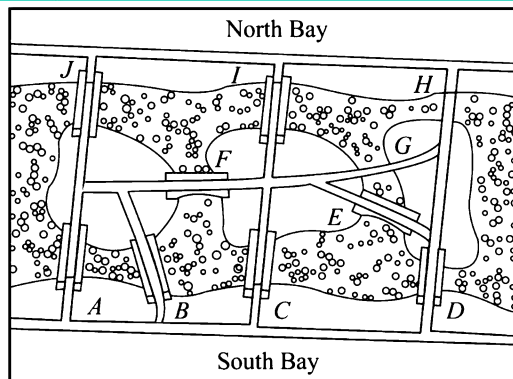


What is the route whose total driving time is less than 30 minutes?

- (A) home, bookstore, credit union, supermarket, home
(B) home, supermarket, bookstore, credit union, home
(C) home, bookstore, supermarket, credit union, home
(D) home, supermarket, credit union, bookstore, home

[ESE 2024]

- The following map shows the 10 bridges and 3 islands between the suburbs of North Bay and South Bay. During your morning workout, you decide to jog over each bridge exactly once. Which one of the following statements is correct?



- (A) You want to start from North Bay and that your workout concludes after you jog over the 'D' bridge.
- (B) You want to start from North Bay and that your workout concludes after you jog over the 'E' bridge.
- (C) You want to start from North Bay and that your workout concludes after you jog over the 'H' bridge.
- (D) You want to start from North Bay and that your workout concludes after you jog over the 'G' bridge.

[ESE 2024]

6. A specimen of steel having an original diameter of 12.8 mm is tensile tested to fracture and found to have engineering fracture strength σ_f of 460 MPa. If its cross sectional diameter at fracture is 10.7 mm, the ductility in terms of percent reduction in area will be
- (A) 25% (B) 30%
- (C) 35% (D) 40%

[ESE 2025]

7. A special server-side programs that acts between the Hyper Text Transfer Protocol HTTP server and other local resources such as databases is
- (A) HTML programs
- (B) Java Script programs
- (C) Gateway programs

(D) High Level programs

[ESE 2025]

8. Nandini walks a distance of 1 km towards North. She then turns left and walks 1 km. Finally she turns right at an angle of 45° and starts walking. In which direction she is moving finally ?
- (A) South West
- (B) North-West
- (C) North-East
- (D) South-East

Answers **Mixture Alligation & Direction**

3.1	B	3.2	D	3.3	C	3.4	A	3.5	A
3.6	C	3.7	A	3.8	A	3.9	C	3.10	D
3.11	A	3.12	D	3.13	C	3.14	D	3.15	B
3.16	C	3.17	B	3.18	A	3.19	C	3.20	C
Engineering Services Examination (ESE)									
1.	B	2.	C	3.	B	4.	C	5.	B
6.	B	7.	C	8.	B				

Explanations **Mixture Alligation & Direction**
3.1 (B)

Given :

Initially the tank is having 100 litres of water.

Every hour, the capacity changes as

$$C' = C \left(1 + \frac{m}{100}\right) \left(1 - \frac{n}{100}\right)$$

So, after 5 hours we get

$$C' = 100 \left(1 + \frac{m}{100}\right)^5 \left(1 - \frac{n}{100}\right)^5$$

$$\left(1 + \frac{m}{100}\right)^5 \left(1 - \frac{n}{100}\right)^5 = 1$$

$$\left(1 + \frac{m}{100}\right) \left(1 - \frac{n}{100}\right) = 1$$

$$1 + \frac{m}{100} - \frac{n}{100} - \frac{mn}{10000} = 1$$

$$100(m - n) = mn$$

Since, $mn > 0$, $m - n > 0 \Leftrightarrow m > n$.

Hence, the correct option is (B).

3.2 (D)

Given : Original quantity of spirit = 10 litres

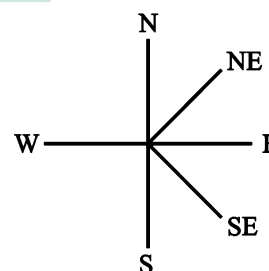
Let x be the total amount of solution and y be the amount of solution which is replaced each time.

Then, $\left(1 - \frac{y}{x}\right)^n = \frac{\text{Spirit left after 3rd operation}}{\text{Initial quantity of spirit}}$

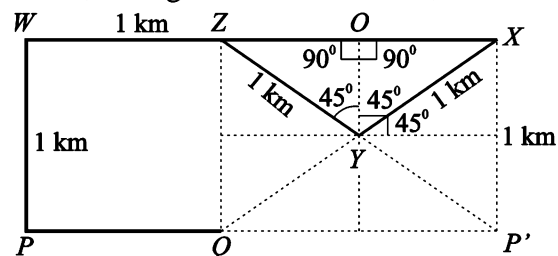
Spirit left after 3rd operation

$$= 10 \left(1 - \frac{1}{10}\right)^3 = 10 \times \left(\frac{9}{10}\right)^3 = 7.29 \text{ litres}$$

Hence, the correct option is (D).

3.3 (C)


According to the given statements in the question, the figure is shown below,



According to Pythagoras theorem,

In triangle XYZ,

$$ZX^2 = ZY^2 + YX^2 = 1^2 + 1^2 = 2$$

$$ZX = \sqrt{2}$$

From above figure,

$$ZX = P'Q = \sqrt{2}$$

In triangle QXP',

$$QX^2 = P'X^2 + P'Q^2 = 1^2 + (\sqrt{2})^2$$

$$QX = \sqrt{3}$$

Hence, the correct option is (C).

3.4 (A)

Let the capacity of tank = C litres

Time taken to empty half full tank i.e. $\frac{C}{2}$ litres

$$= 30 \text{ mins}$$

So draining rate,

$$y = \frac{C/2}{30} = \frac{C}{60} \text{ litres/min} \quad \dots(i)$$

Let the filling rate = x litres/min

Net rate of filling (when simultaneously filling and draining) = $x - y$ (let $x > y$)

The half-full tank, i.e. to fill remaining $\frac{C}{2}$

Time taken = 10 mins

$$\frac{C/2}{10} = x - y$$

From equation (i),

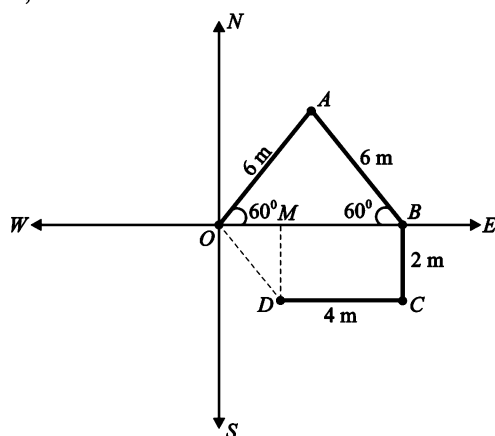
$$x - y = \frac{C}{20} = \frac{1}{20} \times 60y$$

$$x = 4y$$

Hence, the correct option is (A).

3.5 (A)

According to given data, the figure is shown below,



From figure,

$$\angle AOB = \angle OBA = 60^\circ$$

Triangle OAB is an equilateral triangle because

$$\angle OAB + \angle ABO + \angle BOA = 180^\circ$$

$$\angle OAB + 60^\circ + 60^\circ = 180^\circ$$

$$\angle OAB = 60^\circ$$

Hence, $OB = 6$ m, $MD = BC = 2$ m

$$OM = OB - MB$$

$$OM = 6 - 4 = 2$$

From figure,

$$OD^2 = OM^2 + MD^2$$

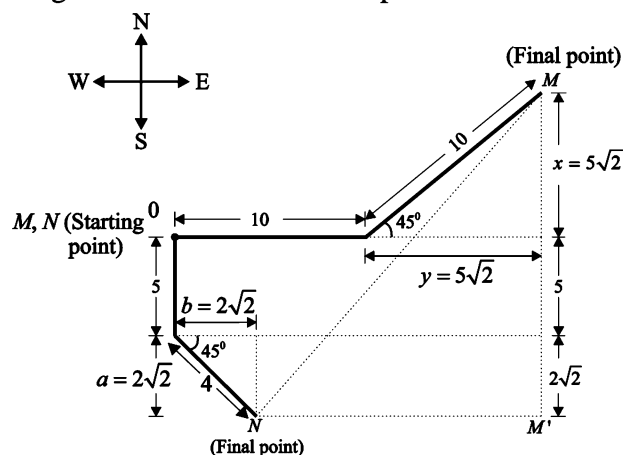
$$OD^2 = 2^2 + 2^2$$

$$OD = 2\sqrt{2} \text{ m}$$

Hence, the correct option is (A).

3.6 (C)

According to the given question, the following diagram shows the travelled path.



$$\sin 45^\circ = \frac{x}{10}$$

$$x = 10 \sin 45^\circ = 5\sqrt{2}$$

$$\tan 45^\circ = \frac{x}{y} = \frac{5\sqrt{2}}{y}$$

$$y = 5\sqrt{2}$$

Similarly,

$$\sin 45^\circ = \frac{a}{4}$$

$$a = 2\sqrt{2}$$

$$\tan 45^\circ = \frac{a}{b}$$

$$b = 2\sqrt{2}$$

$$MM' = 5\sqrt{2} + 5 + 2\sqrt{2}$$

$$MM' = 5 + 7\sqrt{2}$$

$$NM' = 10 + 5\sqrt{2} - 2\sqrt{2}$$

$$NM' = 10 + 3\sqrt{2}$$

By Pythagoras theorem,

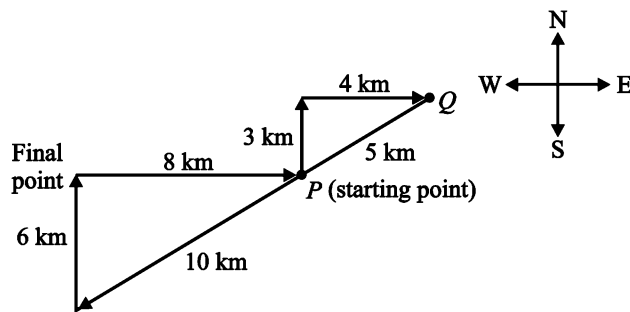
$$MN = \sqrt{(MM')^2 + (NM')^2}$$

$$MN = \sqrt{(5 + 7\sqrt{2})^2 + (10 + 3\sqrt{2})^2}$$

$$MN = 20.61$$

Hence, the correct option is (C).

3.7 (A)



Clearly, she needs to go 8 km east to reach P.

Hence, the correct option is (A).

3.8 (A)

Given : There are 5 buildings V, W, X, Y and Z.

V is to the West of W: (V) - W

Z is to the East of X: X - (Z)

Z is also to the West of V: (X - Z) - V - W

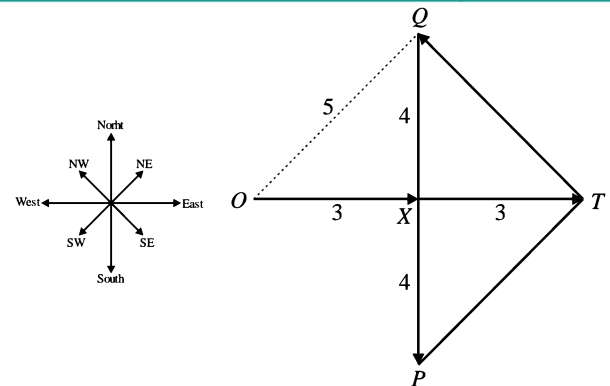
W is to the West of Y: (X - Z - V - W) - Y

The building in the middle is V.

Hence, the correct option is (A).

3.9 (C)

Given : According to the given data the figure is shown below,



The distance of point Q to point O is,

$$OQ = \sqrt{OX^2 + XT^2}$$

$$OQ = \sqrt{3^2 + 4^2} = \sqrt{9 + 16}$$

$$OQ = \sqrt{25}$$

$$OQ = 5 \text{ units}$$

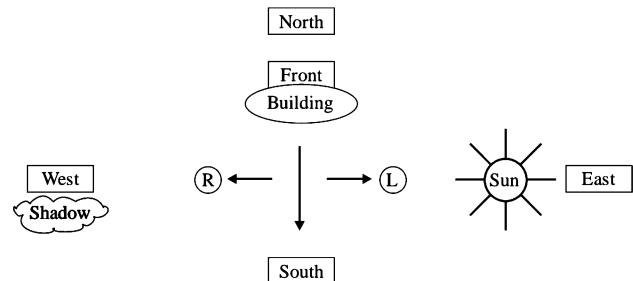
Thus the distance of point Q to point O, 5 units.

Hence, the correct option is (C).

3.10 (D)

Given :

According to the given data the figure is shown below,



As per the diagram shown above,

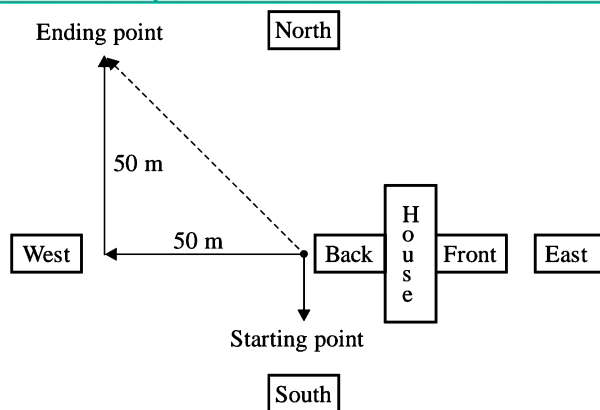
Shadow of Ms. X is to her right side. So that she is facing to the South direction and building is to her back so that building will also face to South direction.

Hence, the correct option is (D).

3.11 (A)

Given :

According to the given data the figure is shown below,



As per the diagram shown above,
At the end Mr. X is in North-West direction with respect to the starting point.

Hence, the correct option is (A).

3.12 (D)

Given : The price of an item is 10% cheaper in an online store S compared to the price at another online store M.

Delivery charges of an item at the online store S and M is ₹150 and 0 respectively.

Cost of an item from the online store S is ₹100 less than the item from online store M.

Let, the price of an item at the online store M is ₹ x .

Then price of an item at the online store S is $(x - 0.1x) = 0.9x$

So, $x - (0.9x + 150) = 100$

$$0.1x - 150 = 100$$

$$0.1x = 250$$

$$x = 2500$$

The price of the item at the online store S (in ₹) without any delivery charges is $0.9x$

$$= 0.9 \times 2500 = 2250$$

Hence, the correct option is (D).

3.13 (C)

Given : A sum of money is to be distributed among P, Q, R and S is $5x$, $2x$, $4x$ and $3x$ respectively.

Where x is a common multiplication factor.

As R gets ₹1000 more than S.

$$\text{Then, } 4x - 3x = 1000$$

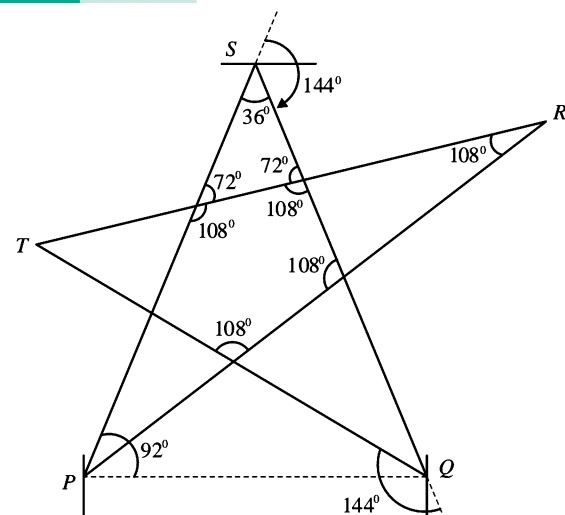
$$x = 1000$$

Now, share of Q is $2x = 2 \times 1000 = ₹2000$

Share of Q is ₹2000.

Hence, the correct option is (C).

3.14 (D)



$$PS = SQ = QT = TR = RP = 10 \text{ cm}$$

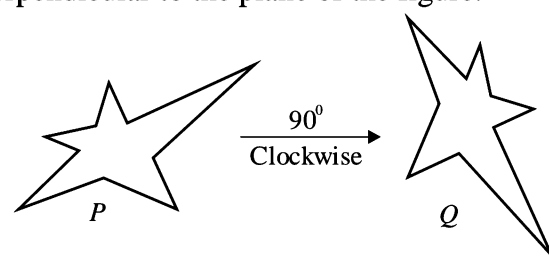
Hence, the correct option is (D).

3.15 (B)

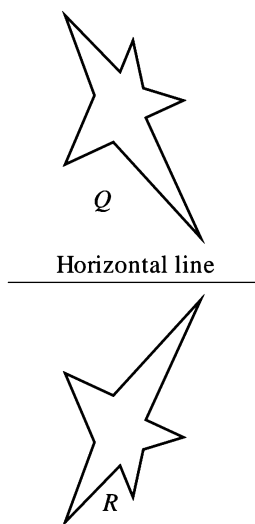
Given : The transformation of the 2-dimensional figure P to Q, and then to R as shown in below figure,



We can clearly see from P to Q, operation 1 is a clockwise rotation by 90° about an axis perpendicular to the plane of the figure.



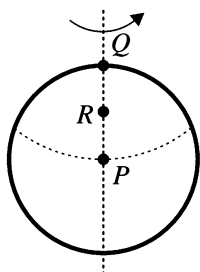
Form Q to R , operation 2 is a reflection along a horizontal line.



Hence, the correct option is (B).

3.16 (C)

Given : A spherical globe rotating about an axis passing through its poles. There are three points P , Q , and R situated respectively on the equator, the north pole, and midway between the equator and the north pole in the northern hemisphere. Let P , Q , and R move with speeds v_P , v_Q and v_R , respectively.



Here, velocity $V = \omega r$ and $\omega = \text{Constant}$.

Hence, more is the distance from the axis of rotation more will be the velocity.

Hence, $v_P > v_R > v_Q$.

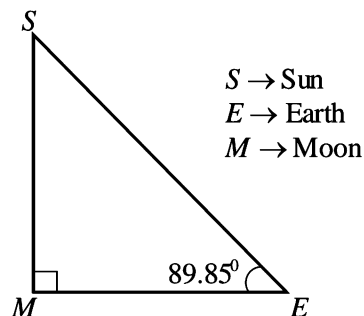
Hence, the correct option is (C).

3.17 (B)

Given : Earth-Moon-Sun form a right triangle.

Moon-Earth-Sun angle $= 89.85^\circ$

i.e., $\angle MES = 89.85^\circ$



We know that estimated distance from earth to the Moon = 240000 mile

i.e., $EM = 240000 \text{ mile}$

In the right angled triangle

$$\cos \theta = \frac{B}{H}$$

$$\cos \theta = \frac{EM}{ES}$$

$$ES = \frac{EM}{\cos \theta} = \frac{240000}{\cos 89.85^\circ}$$

$$ES = \frac{240000}{0.0026} = 92307692.3$$

Ratio of Earth-Sun and Earth-Moon distance

$$\begin{aligned}
 &= \frac{ES}{EM} \\
 &= \frac{92307692.3}{240000} = 384.61 \approx 382
 \end{aligned}$$

Hence, the ratio of Earth-Sun and Earth-Moon distance is closest to 382.

Hence, the correct option is (B).

3.18 (A)

Selling price of P & Q mixture with 8% profit is Rs. 192/kg

C.P of P = Rs.160/kg

C.P of Q = Rs. 200/kg

@ 8% profit S.P. of P & Q = Rs. 192/kg

$$\text{C.P. of mixture } P \text{ \& } Q = \frac{100 \times 192}{108} = \frac{1600}{9}$$

By allegation and mixture

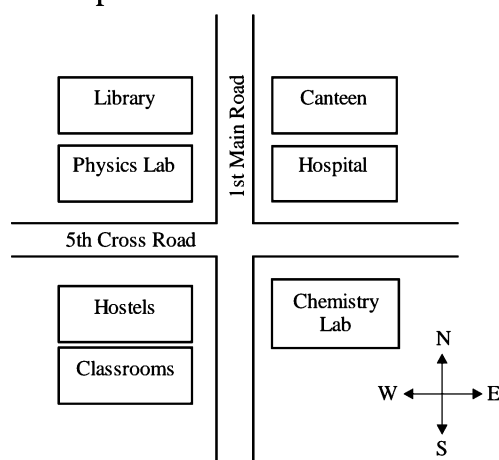
$$\begin{array}{ccc}
 \begin{array}{cc} P & Q \\ 160 & 200 \\ \hline & 1600 \\ & \times 9 \end{array} &
 \begin{array}{cc} P & Q \\ 160 \times 9 & 200 \times 9 \\ \hline & 1600 \times 9 \end{array} & \Rightarrow &
 \begin{array}{cc} P & Q \\ 1440 & 1800 \\ \hline & 1600 \\ & \times 9 \end{array} \\
 \end{array}$$

Ratio of $P : Q = 5 : 4$

Hence, the correct option is (A).

3.19 (C)

Given : Map is shown below.



From option (A) : From the above map, the library is located to west of the canteen.

So, option (A) is not correct.

From option (B) : From the above map, the hospital is located to north of the chemistry lab.

So, option (B) is not correct.

From option (C) : From the above map, the chemistry lab is to the south east of physical lab.

So, option (C) is correct.

From option (D) : From the above map, the classroom is located south west of canteen.

So, option (D) is not correct.

Hence, the correct option is (C).

3.20 (C)

1. Identify East-West Positions

We have four positions from West to East: W1 (Westernmost) — W2 — W3 — W4 (Easternmost).

Constraint (iv) : "Two hills are located to the west of H2."

- This means H2 must be in the 3rd position (W3).

• **Positions :** _ — _ — H2 — _

Constraint (i) & (ii) : Neither H2 nor H3 is the easternmost or westernmost.

- Since H2 is already at W3, H3 must take the only other middle spot, which is W2.
- **Positions :** _ — _ — H2 — _

The Extremes : This leaves H1 and H4 for the Westernmost (W1) and Easternmost (W4) spots.

2. Identify the Southernmost Hill

Now we look at the North-South constraints.

Constraint (iii) : "Neither the easternmost hill nor the westernmost hill is the southernmost hill."

- This means the southernmost hill cannot be H1 or H4.
- Therefore, the southernmost hill must be either H2 or H3.

Constraint (v) : "The southernmost hill has at least two hills to its east."

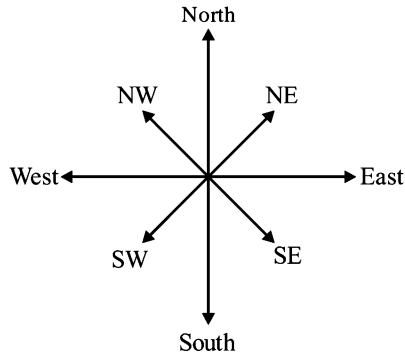
- Let's check our East-West map: W1 — H3 — H2 — W4 .
- If H2 were the southernmost, it only has one hill to its east (W4). This fails the "at least two" rule.
- If H3 is the southernmost, it has two hills to its east (H2 and W4). This fits perfectly.

1. **East-west order :** (H1/H4) — H3 — H2 — (H4/H1).

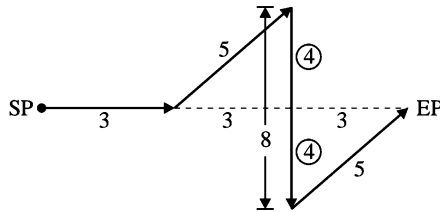
2. **Southern candidates :** Must be H2 or H3 (Rule iii).

3. **Position check :** H3 has two hills to its (East), satisfying rule v .

Hence, the correct option is (C).

Engineering Services Examination (ESE)**1. (B)**

According to the given data the figure is shown below,



SP : Starting point

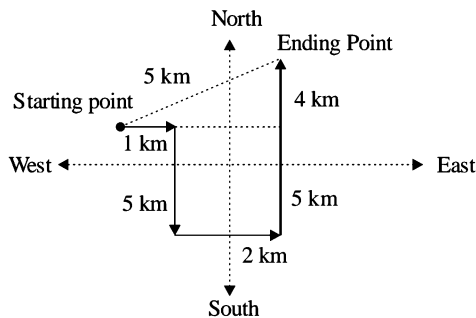
EP : Ending point

The minimum distance between SP and EP will be, $3 + 3 + 3 = 9 \text{ km}$

Hence, the correct option is (B).

2. (C)

According to Given Conditions

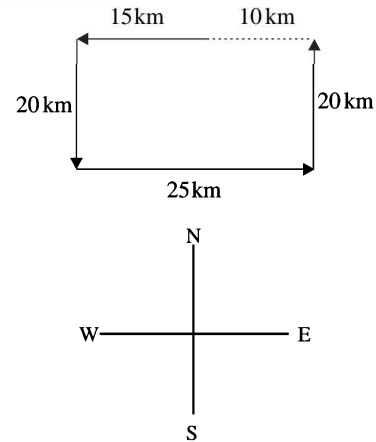


Distance of the man from his starting

$$\text{Point} = \sqrt{(3)^2 + (4)^2} = \sqrt{25} = 5 \text{ km}$$

So the man is 5 km far from his starting point

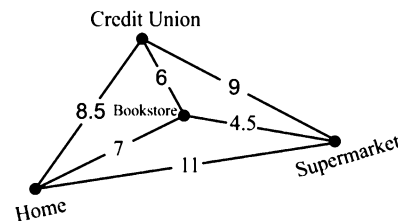
Hence, the correct option is (C).

3. (B)

Hence the correct option is (B).

4. (C)

Given :



From option (A) :

Home → Bookstore → Credit union → Super market → Home

$$\begin{aligned} \text{For this Route} &= (7 + 6 + 9 + 11) \\ &= (13 + 20) = 33 \text{ minutes.} \end{aligned}$$

From option (B) :

Home → Super market → Bookstore → Credit union → Home

$$\begin{aligned} \text{For this Route} &= (11 + 4.5 + 6 + 8.5) \\ &= (17 + 13) = 30 \text{ minutes} \end{aligned}$$

From option (C) :

Home → Bookstore → Super market → Credit union → Home

$$\begin{aligned} \text{For this Route} &= (7 + 4.5 + 9 + 8.5) \\ &= (16 + 13) = 29 \text{ minutes} \end{aligned}$$

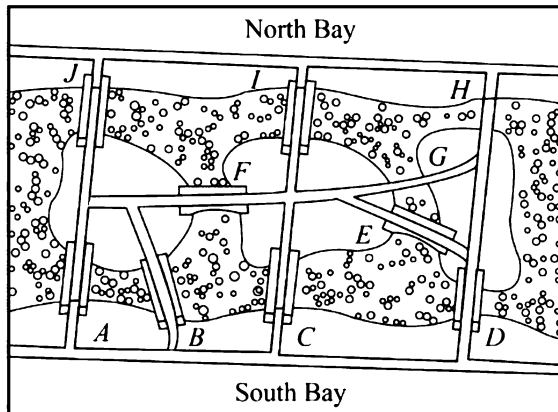
From option (D) :

Home → Super market → Credit union → Bookstore → Home

$$\begin{aligned} \text{For this Route} &= (11 + 9 + 6 + 7) \\ &= (20 + 13) = 33 \text{ minutes} \end{aligned}$$

Hence the correct option is (C).

5. (B)



Starting from J, we then move on to A, followed by B, F, I, H, G, C, D and finally E.

Hence, the correct option is (B).

6. (B)

The ductility in terms of percent reduction is

$$\begin{aligned} \%RA &= \left(\frac{A_0 - A_f}{A_0} \right) \times 100 \\ &= \frac{\pi \frac{d_0^2}{4} - \pi \frac{d_f^2}{4}}{\pi \frac{d_0^2}{4}} \times 100 = \frac{d_0^2 - d_f^2}{d_0^2} \times 100 \\ &= \frac{(12.8)^2 - (10.7)^2}{(12.8)^2} \times 100 \approx 30\% \end{aligned}$$

d_0 = original diameter

d_f = diameter at fracture

Hence, the correct option is (B).

7. (C)

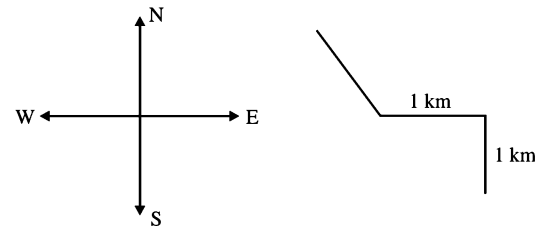
Common Gateway Interface (CGI) or a server-side component acts as intermediary between the web server and backend services like databases. These are known as Gateway

Programmes. HTML and JavaScript are not intermediate programmes.

Hence, the correct option is (C).

8. (B)

1. Start → North 1 km.
2. Turn Left (90° counter-clockwise) → She is now walking West.
3. Turn Right at 45° (from the West direction) → Turning 45° right from West points her towards the North-West.



Hence, the correct option is (B).



4

Permutation & Combination

To understand the concept of permutation and combination let us take an example. Suppose a person has 3 alphabets A, B and C . He is asked to arrange any two alphabets and then AB, BA, BC, CB, CA or AC should be the required arrangements. But if asked to choose any two from the group of three alphabets, then his selection will be like this AB, BC or CA . Here the difference is or order. In arrangement order of the objects arranged is important and plays a very important role as AB and BA are two different arrangements. While in case of selection order is not important and AB and BA both are same and consider identical.

So, permutation deals with the arrangements of the objects in the given conditions, while combination deals with the selection of the objects.

CONCEPT OF ${}^n P_r$ OF AND ${}^n C_r$:

${}^n P_r$ represents number of arrangement of r objects out of total of n different objects.

Example : If 5 persons have to sit on 7 sofas in a row. Then total number of ways they can sit will be equal to ${}^7 P_5 = \frac{7!}{(7-5)!} = \frac{7!}{2!} = 2520$ ways.

${}^n C_r$ represents number of selection of r objects out of total of n different objects.

Example : If a team of 11 fielders has to be selected from the group of 14 players, then number of ways will be ${}^{14} C_{11} = \frac{14!}{11! \times (14-11)!} = 364$ ways.

FORMULAE OF PERMUTATION :

1. Permutation of n different things taken ' r ' at a time is denoted by ${}^n P_r$ and is given by,

$${}^n P_r = \frac{n!}{(n-r)!}$$

2. The total number of arrangements of n things taken r at a time, in which a particular things occurs $= {}^{n-1} P_{r-1}$.

Example : The number of ways in a game in which 5 players out of 8 players selected can play at different positions such that captain always plays in centre position $= {}^{8-1} P_{5-1} = {}^7 P_4 = 210$.

3. The total number of permutations of n different things taken r at a time in which a particular thing never occurs $= {}^{n-1}P_r$.

Example : The number of ways in which we can form a 4 letter word from the letters of the word *COMBINE* such that the word never contain $B = {}^{7-1}P_4 = {}^6P_4 = 30$.

4. The number of arrangements when things are not all different such as arrangement of n things, when p of them is of one kind, q is of another kind, r is of another kind and so on, then the total number of permutations is given by $\frac{n!}{(p!q!r!.....)}$.

Example : The total arrangements of letters of the word "A L G E B R A" In which A is repeated twice $= \frac{7!}{2!}$.

5. The number of permutations of n different things taking r at a time when each thing may be repeated any number of times in any permutations is given by $(n \times n \times n \times n \times n \dots r \text{ times}) n^r$ ways.

FORMULAE OF COMBINATION :

1. Number of combinations of n dissimilar things taken ' r ' at a time is denoted by ${}^nC_r$ and is given by,

$${}^nC_r = \frac{n!}{(n-r)!r!}$$

2. Number of combinations of n different things taken ' r ' at a time in which p particular things will always occur is ${}^{n-p}C_{r-p}$.

Example : The number of ways a team of 5 players chosen from 8 players, so that the captain should be included in the team $= {}^{8-1}C_{5-1} = {}^7C_4 = 35$.

3. Number of combinations of n dissimilar things taken ' r ' at a time in which ' p ' particular things will never occur is ${}^{n-p}C_r$.

Example : The number of ways a basketball team of 5 players chosen from 10 players, such that the player named Ranjeet should not be included in the team $= {}^{10-1}C_5 = {}^9C_5 = 126$.

4. The number of ways in which $(m + n)$ things can be divided into two groups containing m and n things respectively.

$${}^{(m+n)}C_n = \frac{(m!n!)}{(m!+n!)} = {}^{(m+n)}C_m$$

5. The number of ways to divide n things into different groups, one containing p things, another q things and so on is equal to $\frac{(p+q+r+.....)!}{(p!q!r!.....)}$.

CIRCULAR PERMUTATIONS :

In linear permutation, we fill first place by n ways and next in $(n - 1)$ ways and so on, but in circular arrangement we don't have any first place. So fix any object as a first place and arrange $(n - 1)$ objects around it. Hence, we have to arrange one less than the total number of things.

1. Number of circular permutations of n things taken all at a time $= (n - 1)!$
2. Number of circular permutations of n different things taking r at a time $= \frac{{}^n P_r}{r}$.
3. If there is no difference between clockwise and anticlockwise arrangements, the total number of circular permutations of n things taking all at a time is $\frac{(n-1)!}{2}$ and the total number of circular permutation of n things taking r at a time is $\frac{{}^n P_r}{2r}$.

**2010 IIT Guwahati**

- 4.1** 25 persons are in a room. 15 of them play hockey, 17 of them play football and 10 of them play both hockey and football. Then the number of persons playing neither hockey nor football is

[All branches]

- (A) 2 (B) 17
(C) 13 (D) 3

- 4.2** A student is answering a multiple choice examination with 65 questions with a marking scheme as follows : (i) 1 mark for each correct answer, (ii) $-\frac{1}{4}$ for a wrong answer, (iii) $-\frac{1}{8}$ for a question that has not been attempted. If the student gets 37 marks in the test then the least possible number of questions the student has NOT answered is : [TF]

- (A) 6 (B) 5
(C) 7 (D) 4

2011 IIT Madras

- 4.3** In how many ways 3 scholarships can be awarded to 4 applicants, when each applicant can receive any number of scholarships? [AE, MN]
(A) 4 (B) 12
(C) 64 (D) 81

2012 IIT Delhi

- 4.4** Ten teams participate in a tournament. Every team plays each of the other teams twice. The total number of matches to be played is [AR, GG, TF]
(A) 20 (B) 45
(C) 60 (D) 90
- 4.5** A smuggler has 10 capsules in which five are filled with narcotic drugs and the rest contain the original medicine. All the 10 capsules are mixed in a single box, from which the customs officials picked two capsules at random and tested for the presence of narcotic drugs. The probability that the smuggler will be caught is [AR, GG, TF]
(A) 0.50 (B) 0.67
(C) 0.78 (D) 0.82

2015 IIT Kanpur

- 4.6** Five teams have to compete in a league, with every team playing every other team exactly once, before going to the next round. How many matches will have to be held to complete the league round of matches?

[AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]

- (A) 20 (B) 10
(C) 8 (D) 5

2017 IIT Roorkee

- 4.7** There are 3 Indians and 3 Chinese in a group of 6 people. How many subgroups of this group can we choose so that every subgroup has at least one Indian?

[BT, CY, EC-1, EY, PI]

- (A) 56 (B) 52
(C) 48 (D) 44

- 4.8** There are 3 red socks, 4 green socks and 3 blue socks. You choose 2 socks. The probability that they are of the same colour is

[CS-2, EE-2]

- (A) $1/5$ (B) $7/30$
(C) $1/4$ (D) $4/15$

- 4.9** Six people are seated around a circular table. There are atleast two men and two women. There are atleast three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is

[CS-1, EE-1]

- (A) 2
(B) 3
(C) 4
(D) Cannot be determined

- 4.10** Arun, Gulab, Neel and Sweta must choose one shirt each from a pile of four shirts coloured red, pink, blue and white respectively. Arun dislikes the colour red and Sweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts so that no one has a shirt with a colour he or she dislikes?

[CS-1, EE-1]

- (A) 21 (B) 18
(C) 16 (D) 14

- 4.11** A test has twenty questions worth 100 marks in total. There are two types of questions. Multiple choice questions are worth 3 marks each and essay questions are worth 11 marks each. How many multiple choice questions does the exam have?

[CS-2, EE-2]

- (A) 12 (B) 15
(C) 18 (D) 19

- 4.12** There are 4 women P, Q, R, S and 5 men V, W, X, Y, Z in a group. We are required to form pairs each consisting of one woman and one man P is not to be paired with Z and Y must necessarily be paired with someone. In how many ways can 4 such pairs be formed?

[AG, GG, ME-2]

- (A) 74 (B) 76
(C) 78 (D) 80

2018 IIT Guwahati

- 4.13** An e-mail password must contain three characters. The password has to contain one numeral from 0 to 9, one upper and one lower case character from the English alphabet. How many distinct passwords are possible?

[EE]

- (A) 6,760 (B) 13,520
(C) 40,560 (D) 1,05,456

- 4.14** A three-member committee has to be formed a group of 9 people. How many such distinct committees can be formed?

[CE-2]

- (A) 27 (B) 72
(C) 81 (D) 84

2019 IIT Madras

- 4.15** Five different books (P, Q, R, S, T) are to be arranged on a shelf. The books R and S are to be arranged first and second respectively from right side of the shelf. The number of different orders in which P, Q and T may be arranged is _____.

[EC]

- (A) 6 (B) 2
(C) 12 (D) 120

2022 IIT Kharagpur

- 4.16** A box contains five balls of same size and shape. Three of them are green coloured balls and two of them are orange coloured balls. Balls are drawn from the box one at a time. If a green ball is drawn it is not replaced. If an orange ball is drawn it is replaced with another orange ball. First ball is drawn. What is the probability of getting an orange ball in the next drawn?

[CSE]

- (A) $\frac{23}{50}$ (B) $\frac{19}{50}$
(C) $\frac{8}{25}$ (D) $\frac{1}{2}$

- 4.17** There are two identical dice with a single letter on each of the faces. The following six letters : Q, R, S, T, U and V, one on each of the faces. Any of the six outcomes are equally likely.

The two dice are thrown once independently at random.

What is the probability that the outcomes on the dice were composed only of any combination of the following possible outcomes : Q, U and V?

[EE]

- (A) $\frac{1}{6}$ (B) $\frac{3}{4}$
(C) $\frac{5}{36}$ (D) $\frac{1}{4}$

- 4.18** A person travelled 80 km in 6 hours. If the person travelled the first part with a uniform speed of 10 kmph and the remaining part with a uniform speed of 18 kmph.

What percentage of the total distance is travelled at a uniform speed of 10 kmph?

[ME-1]

- (A) 28.25 (B) 37.25
(C) 43.75 (D) 50.00

2023 IIT Kanpur

- 4.19** In a class of 100 students,

[ECE]

- (i) there are 30 students who neither like romantic movies nor comedy movies,
(ii) the number of students who like romantic movies is twice the number of students who like comedy movies, and
(iii) the number of students who like both romantic movies and comedy movies is 20.

How many students in the class like romantic movies?

- (A) 40 (B) 20
(C) 60 (D) 30

- 4.20** Out of 1000 individuals in the town, 100 unidentified individuals are covid

positive. Due to lack of adequate covid-testing kits, the health authorities of the town devised a strategy to identify these covid positive individuals. The strategy is to :

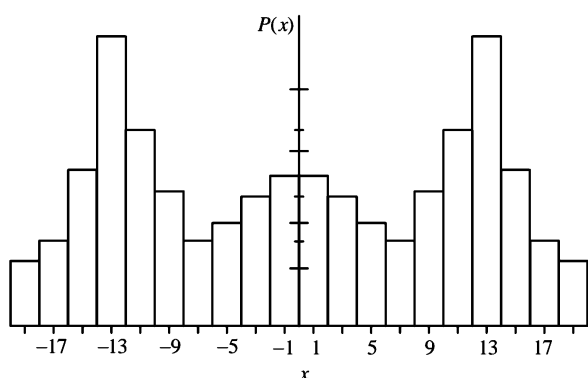
[ECE]

- (i) Collect saliva sample from all 1000 individual and randomly group them into sets of 5.
- (ii) Mix the samples within each set and test the mixed sample for covid.
- (iii) If the test done in (ii) gives a negative result, then declare all the 5 individual to be covid negative.
- (iv) If the test done in (ii) give positive result, then all the 5 individuals are separately tested for covid.

Given this strategy, no more than _____ testing kits will be required to identify all the 100 covid positive individuals irrespective of how they are grouped.

- (A) 700 (B) 600
(C) 800 (D) 1000

- 4.21 Which one of the options can be inferred about the mean, median, and mode for the given probability distribution (*i.e.* probability mass function), $P(x)$, of a variable x ?



[CE-1]

- (A) mean = median $\neq$ mode
(B) mean = median = mode
(C) mean $\neq$ median = mode
(D) mean $\neq$ mode = median

- 4.22 Let $a = 30!$, $b = 50!$ & $c = 100!$ Consider the following numbers :

$$\log_a c, \log_c a, \log_b a, \log_a b$$

Which one of the following inequalities is CORRECT?

[CE-1]

- (A) $\log_c a < \log_b a < \log_a b < \log_a c$
(B) $\log_c a < \log_a b < \log_b a < \log_b c$
(C) $\log_c a < \log_b a < \log_a c < \log_a b$
(D) $\log_b a < \log_c a < \log_a b < \log_a c$

2024 IISc Bangalore

- 4.23 How many combinations of non-null sets A, B, C are possible from the subsets of $\{2, 3, 5\}$ satisfying the conditions: (i) A is a subset of B , and (ii) B is a subset of C ?

- (A) 28 (B) 27
(C) 18 (D) 19

[ME]

- 4.24 Two wizards try to create a spell using all the four elements, water, air, fire, and earth. For this, they decide to mix all these elements in all possible orders. They also decide to work independently. After trying all possible combination of elements, they conclude that the spell does not work.

How many attempts does each wizard make before coming to this conclusion, independently?

- (A) 24 (B) 48
(C) 16 (D) 12

[CS-2]

2025 IIT Roorkee

- 4.25** A shop has 4 distinct flavors of ice-cream. One can purchase any number of scoops of any flavor. The order in which the scoops are purchased is inconsequential.

If one wants to purchase 3 scoops of ice-cream, in how many ways can one make that purchase? **[CS-1]**

- (A) 4 (B) 20
(C) 24 (D) 48

2026 IIT Guwahati

- 4.26** How many 3-digit numbers can be formed using three distinct single digit prime numbers? **[CH]**

- (A) 64 (B) 24
(C) 12 (D) 4

Engineering Services Examination (ESE)

- 1.** A library has two books each having three copies and three other books each having two copies. In how many ways can all these books be arranged in a shelf so that copies of the same book are not separated?

- (A) 80 (B) 100
(C) 120 (D) 140

[ESE 2022]

- 2.** If six people greet each other at a meeting by shaking hands with one another, how many handshakes will take place?

- (A) 14 (B) 16
(C) 15 (D) 18

[ESE 2024]

Answers

Permutation & Combination

4.1	D	4.2	A	4.3	C	4.4	D	4.5	C
4.6	B	4.7	A	4.8	D	4.9	A	4.10	D
4.11	B	4.12	C	4.13	C	4.14	D	4.15	A
4.16	A	4.17	D	4.18	C	4.19	C	4.20	A
4.21	A	4.22	A	4.23	MTA	4.24	A	4.25	B
4.26	B								
Engineering Services Examination (ESE)									
1.	C	2.	C						

Explanations

Permutation & Combination

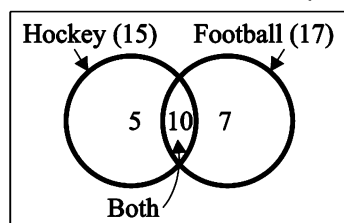
4.1 (D)

Given : There are 25 persons in a room.

Method 1

Total numbers of players

$$= \text{Hockey only} + \text{Football only} \\ + \text{Both hockey and football}$$



From Venn diagram,

$$\text{Total number of players} = 5 + 7 + 10 = 22$$

Therefore, number of persons playing neither hockey nor football = $25 - 22 = 3$

Hence, the correct option is (D).

Method 2

From set theory,

$n(A)$: Number of people who play hockey = 15

$n(B)$: Number of people who play football = 17

$n(A \cap B)$: Persons who play both hockey and football = 10

$n(A \cup B)$: Persons who play either hockey or football or both

From set theory,

$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

$$n(A \cup B) = 15 + 17 - 10 = 22$$

Total number of persons = 25

Therefore, people who play neither hockey nor football = $25 - 22 = 3$

Hence, the correct option is (D).

4.2 (A)

Given :

Total number of questions = 65

Number of correct answer : n_c

Number of wrong answer : n_w

According to the given marking scheme,

Marks scored

$$= 1 \times n_c - \frac{1}{4} \times n_w - \frac{1}{8} \times [65 - (n_c + n_w)]$$

$$37 = n_c - \frac{1}{4} \times n_w - \frac{1}{8} \times [65 - (n_c + n_w)]$$

$$37 = n_c - \frac{n_w}{4} - \frac{65}{8} + \frac{n_c}{8} + \frac{n_w}{8}$$

$$37 + \frac{65}{8} = n_c + \frac{n_c}{8} - \frac{n_w}{8}$$

$$361 = 9n_c - n_w$$

To minimize the number of unanswered questions we have to maximize $n_c + n_w$.

Possible values of (n_c, n_w) are

$$(41, 8) \Rightarrow 41 + 8 = 49$$

$$(42, 17) \Rightarrow 42 + 17 = 59$$

(43, 26), It is not possible because $43 + 26 > 65$

So, maximum number of unanswered questions

$$= 65 - 59 = 6,$$

(Consider $n_c, n_w = 42, 17$)

Hence, the correct option is (A).

4.3 (C)

One scholarship can be awarded to 4 applicants in 4 ways. Three scholarship can be awarded to 4 applicants in $4^3 = 64$ ways.

(All scholarships are independent, any student can get any number of scholarships between 0 and 3)

Hence, the correct option is (C).

4.4 (A)

Given :

Ten teams participate in a tournament,

Let 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 be the teams.

First team can play with any team in 9 ways.

Similarly, second team play with any team in 8 ways, 3rd team can play 7 games and so on.

So, the total number of games possible

$$= 9 + 8 + 7 \dots + 1 = \frac{n(n-1)}{2} = \frac{10 \times 9}{2} = 45$$

Since, each team plays 2 games against each other, total games $= 45 \times 2 = 90$

Hence, the correct option is (D).

4.5 (C)

The smuggler would be caught if anyone from both the randomly picked capsule contains drugs.

M represents Medicine, D represents Drugs

A : The smuggler will be caught

B : The randomly picked capsules contains M, D

C : The randomly picked capsules contains D, M

D : The randomly picked capsules contains D, D

$$P(A) = P(B) + P(C) + P(D)$$

$$\begin{aligned} P(A) &= \left(\frac{5}{10}\right) \times \left(\frac{5}{9}\right) + \left(\frac{5}{10}\right) \times \left(\frac{5}{9}\right) + \left(\frac{5}{10}\right) \times \left(\frac{4}{9}\right) \\ &= 0.278 + 0.278 + 0.222 \\ &= 0.778 \end{aligned}$$

Hence, the correct option is (C).

4.6 (B)

Given : Total number of teams = 5

Every team will play with every other team exactly once before going to the next round.

Therefore, the total number of combinations of two teams for a match is given by,

(1, 2)(1, 3)(1, 4)(1, 5)
(2, 3)(2, 4)(2, 5)
(3, 4)(3, 5)
(4, 5)

OR

Selection of two teams for a match in total of five teams $= {}^5C_2 = 10$.

There are total 10 combinations.

Hence, the correct option is (B).

4.7 (A)

Given : Number of Indian people = 3

Number of Chinese people = 3

Total number of people = 6

Total number of groups

$$N = 2^n = 2^6 = 64$$

There will be one empty group

So, $N = 64 - 1 = 63$

The number of groups having no Indian people

$$= {}^3C_1 + {}^3C_2 + {}^3C_3 = 7$$

Number of groups having at least one Indian

$$= 63 - 7 = 56$$

Hence, the correct option is (A).

4.8 (D)

Given : Red socks = 3, Green socks = 4,

Blue socks = 3

The probability of choosing two socks of same

$$\begin{aligned} \text{colour} &= \frac{{}^3C_2 + {}^4C_2 + {}^3C_2}{{}^{10}C_2} \\ &= \frac{\frac{3!}{2!1!} + \frac{4!}{2!2!} + \frac{3!}{2!1!}}{\frac{10!}{2!8!}} = \frac{3+6+3}{45} \\ &= \frac{12}{45} = \frac{4}{15} \end{aligned}$$

Hence, the correct option is (D).

4.9 (A)

Given :

- (i) Women are not right handed.
So, Women $\Rightarrow$ Left handed.
- (ii) Person in immediate right of a woman
 $\Rightarrow$ Left handed.
- (iii) At least 2 Men, 2 Women and 3 right handed person are seated.

Assuming the least given conditions,

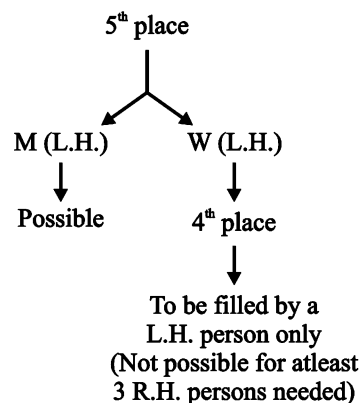
Let 1st place be occupied by a woman, then, 6th place must be occupied by a left handed (L.H.) person.

Again, let this 6th place also be occupied by a woman (W). [W $\Rightarrow$ L.H.]

Now, minimum 2 women are seated.

Since, a woman is in 6th place, a left handed person must sit in 5th place.

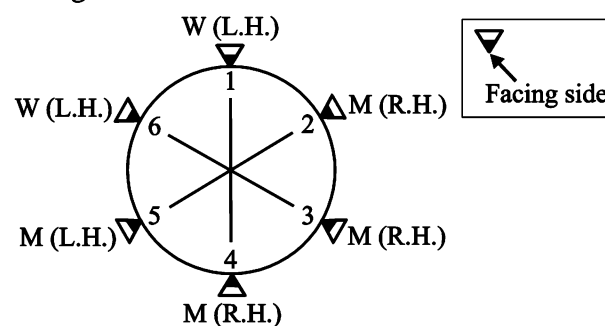
Following conditions possible for the fifth place,



So, the 5th place be occupied by a man (L.H. only).

Since, there should be at least 3 R.H. persons, they can be seated in 2nd, 3rd and 4th places. As a woman cannot be a R.H. person, only R.H. men are seated in 2nd, 3rd and 4th place respectively.

Based on the above discussion, a possible seating arrangement can be as follows :



Thus, only two women can sit at the table.

Hence, the correct option is (A).

4.10 (D)

Given : These are four people (Arun, Gulab, Neel and Sweta) and four colour (Red, Pink, Blue and White).

Total ways of selection without any restriction

$$= 4 + 4 + 4 + 4 = 16$$

[Because every person can choose shirt by 4 ways]

Since, Arun dislikes red.

And Sweta dislikes white.

Therefore, the number of ways to choose the shirts, so that no one has a shirt with colour he or she dislikes

$$= 16 - 2 = 14$$

Hence, the correct option is (D).

4.11 (B)

Given : A test has 20 Questions for 100 marks. There are multiple choice and essay type Questions.

Let, Number of multiple choice questions = X

Then, according to question,

Number of essay questions = $20 - X$

Then, $3X + 11(20 - X) = 100$

$$220 - 8X = 100$$

$$X = \frac{120}{8} = 15$$

Hence, the correct option is (B).

4.12 (C)

Given :

(i) 4 women P, Q, R, S and 5 men V, W, X, Y, Z are in a group.

(ii) A pair should consist one man and one woman but P should not be paired with Z and Y must be paired with someone.

Total pairs that can be formed without any conditions is given by,

$$T_1 = 5 \times 4 \times 3 \times 2 = 120$$

Number of pairs which consist of pair between P and Z is given by,

$$T_2 = 4 \times 3 \times 2 = 24$$

Number of pairs which do not consist Y is given by,

$$T_3 = 4 \times 3 \times 2 \times 1 = 24$$

Number of pairs common between T_2 and T_3 is given by,

$$T_4 = 3 \times 2 \times 1 = 6$$

Therefore, required number of ways to form conditional pairs, is given by,

$$T = T_1 - (T_2 + T_3 - T_4)$$

$$T = 120 - (24 + 24 - 6)$$

$$T = 78$$

Hence, the correct option is (C).

4.13 (C)

For a certain password combination,

One out of 10 digits (0 to 9) can be selected in ${}^{10}C_1 = 10$ ways

One out of 26 capital alphabets ($A, B, \dots, Z$) can be selected in ${}^{26}C_1 = 26$ ways

One out of 26 small alphabets ($a, b, \dots, z$) can be selected in ${}^{26}C_1 = 26$ ways

Also, note that any particular combination can be internally arranged without repetition in $3!$ ways.

So, the total number of possible passwords are

$$= 10 \times 26 \times 26 \times 3! = 6760 \times 6 = 40560$$

Hence, the correct option is (C).

4.14 (D)

Given :

(i) Number of member in a committee = 3

(ii) Number of people in group = 9

Out of 9 people, number of ways to form three member committee = ${}^9C_3 = 84$

Hence, the correct option is (D).

4.15 (A)

As positions of R and S are fixed at first and second from right, so P, Q and T can be arranged in three possible places.

Therefore, total possible arrangements

$$= {}^3P_3 = 3! = 6$$

Hence, the correct option is (A).

4.16 (A)

Given : A box contains five balls of same size and shape.

Three of them are green coloured balls and two of them are orange coloured balls.

Balls are drawn from the box one at a time.

If a green ball is drawn it is not replaced.

If an orange ball is drawn it is replaced with another orange ball.

For the probability of getting an orange ball in the next drawn we have two different cases.

Case 1 : One Green and one Orange

$$P(E) = \frac{3}{5} \times \frac{2}{4} = \frac{6}{20}$$

As we can't replace ball after getting green ball so when we are drawing orange ball at that time only 4 balls are remaining in box.

Case 2 : One Orange and one orange

$$P(E) = \frac{2}{5} \times \frac{2}{5} = \frac{4}{25}$$

As with orange we can replace ball so when we are drawing second orange ball at time 5 balls are present in box.

$$P(E) = \text{case 1} + \text{case 2}$$

$$P(E) = \frac{6}{20} + \frac{4}{25} = \frac{23}{50}$$

Hence, the correct option is (A).

4.17 (D)

Given : Two identical dice with a single letter on each of the faces.

The following six letters : Q, R, S, T, U and V one on each of the faces.

Any of the six outcomes are equally likely.

$P(\text{Event}) = P(\text{getting outcomes from dice one}) \cdot P(\text{getting outcomes from dice two})$

For favorable outcome we need any one of them Q, U, V

$$P(E) = \frac{\text{Favorable outcomes}}{\text{Total outcomes}}$$

$$P(E) = \frac{3}{6} \times \frac{3}{6} = \frac{1}{4}$$

Hence, the correct option is (D).

4.18 (C)

Given :

Total distance covered by a person = 80 km

Total time taken by that person = 6 hours

Speed of first part of journey = 10 kmph

Speed of second part of journey = 18 kmph

Assume, time taken for 1st part = t hrs

Time taken for 2nd part = (6-t) hrs

Distance = Speed × Time

$$80 = 10t + 18(6-t)$$

$$80 = 10t + 108 - 8t$$

$$-28 = -8t$$

$$t = 3.5 \text{ hrs}$$

Distance travelled with speed 10 kmph

$$10 \times 3.5 = 35 \text{ km}$$

Percentage of the total distance is

Travelled at a uniform speed of 10 kmph

$$= \frac{35}{80} \times 100 = 43.75\%$$

Hence, the correct option is (C).

4.19 (C)

Given : There are 100 students from which so students who neither like romantic movies nor comedy movies.

Therefore, $100 - 30 = 70$

70 students will like either romantic or comedy movies.

The number of students who like romantic movie is twice the number of students who like comedy movies.

Let, number of students like comedy movie is x , then number of students like romantic movie is $2x$. the number of students who like both romantic movies and comedy movies is 20.

The number of students in the class like romantic movies,

$$2x + x - 20 = 70$$

$$3x = 90$$

$$x = 30$$

So, $2x = 2 \times 30 = 60$

Therefore, the number of students who like romantic movies are 60.

Hence, the correct option is (C).

4.20 (A)

Given : Number of individuals in town is, 1000
Number of unidentified covid individuals in town is, 100.

Due to lack of adequate covid-testing kits, the health authorities of the town devised a strategy to identify these covid positive individuals. The strategy is to :

- (i) Collect saliva sample from all 1000 individual and randomly group them into sets of 5.

The number of total set required will be,
 $1000 \div 5 = 200$,

- (ii) Mix the samples within each set and test the mixed sample for covid.

For the testing of one set of 5 people, 1 testing kit required

So, for 200 set total 200 testing kit will required

- (iii) If the test done in (ii) gives a negative result, then declare all the 5 individual to be covid negative.

- (iv) If the test done in (ii) give positive result, then all the 5 individuals are separately tested for covid.

The maximum number of 100 unidentified individuals are covid positive.

Let, all unidentified covid positive are in different set, then the number of kits required will be,

Number of people in one set $\times$ Number of set,

$$5 \times 100 = 500 \text{ kits}$$

Maximum number of kits required will be,

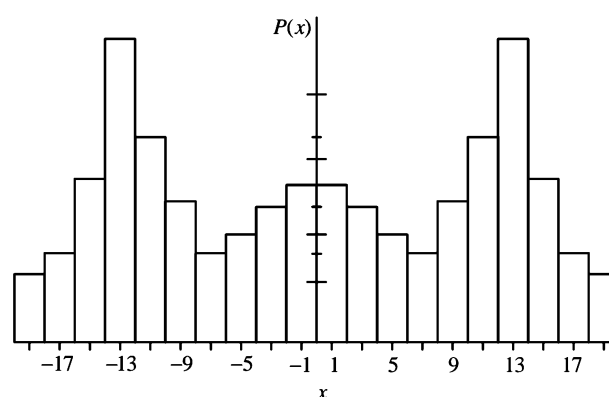
$$200 + 500 = 700 \text{ kits}$$

No more than **700** testing kits will be required to identify all the 100 covid positive individuals irrespective of how they are grouped.

Hence, the correct option is (A).

4.21 (A)

Given : Probability distribution (*i.e.* probability mass function), $P(x)$, of a variable x .



Here, mean (average) of a data set is found by adding all numbers in the data set and dividing by the number of values in the set according to the given data.

Here mean is 0.

Now, the median is the middle value when a data set is ordered from less to greatest.

4.26 (B)

Using the Fundamental Principle of Counting :

Total 3-digit numbers = $4 \times 3 \times 2 = 24$

Alternatively, using the permutation formula ${}^nP_r$

$${}^nP_3 = \frac{4!}{(4-3)!} = \frac{4 \times 3 \times 2 \times 1}{1} = 24$$

Hence, the correct option is (B).

Engineering Services Examination (ESE)**1. (C)**

A library has two books. Each Having 3 copies.

3 other Books. Each Having 2 copies.

Overall we had only 5 books.

Arrangement of 5 books = $5!$

Arrangement of 5 books = 120

Hence the correct option (C).

2. (C)

Given : If Six people greet each other at a meeting by shaking Hands with one another.

The Number of possible Combination

$$\begin{aligned} &= {}^6C_2 = \frac{|6|}{|2||4|} \\ &= \frac{6 \times 5 \times 4!}{(2 \times 1)4!} = 15 \end{aligned}$$

Hence the correct option is (C).





Probability & Statistics

INTRODUCTION :

Probability is a concept which measure the degree of certainty or uncertainty. Probability is basically originated to predict the chance of winning the game, mathematically. A big gambling industry depends upon the basic theory of probability. In general, it is a chance that something will happen in the future or in the given statement.

USEFUL TERMS AND DEFINITIONS :

Sample Space

A sample space is the set of all possible outcomes of the experiment. It is denoted by S . Elements of sample space is referred as sample points. Some important sample space are given as follows :

Coin or Unbiased Coin

1. Tossing a single coin or unbiased coin,

$$S = \{H, T\}$$

Number of sample points = 2

2. Tossing of three coins

$$S = \{HHH, HHT, HTH, HTT, THH, THT, TTH, TTT\}$$

Number of sample points = 8

3. In general for tossing of n coins, $S = 2^n$
where, n = Number of coins

Coins

1 st	2 nd	3 rd
H	H	H
H	H	T
H	T	H
H	T	T
T	H	H
T	H	T
T	T	H
T	T	T

Fig. Sample space of 3 coins

Dice or a Fair Die

1. For throwing a dice $S = \{1, 2, 3, 4, 5, 6\}$

Number of sample point = 6

2. For throwing two dice

Sum of two dice (sample space and total favorable events)



Number of sample points = 36

3. In general for throwing n dice

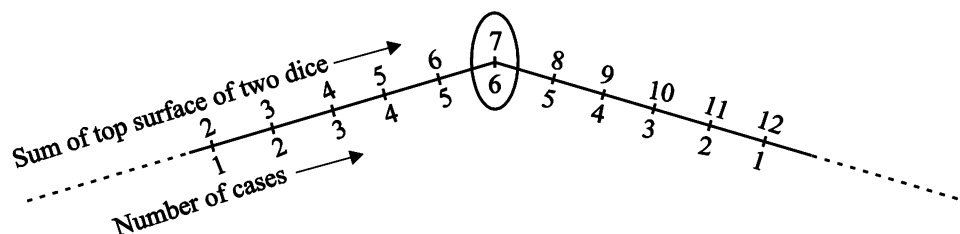
$$S = 6^n \quad \because \quad n = \text{Number of dice}$$

Triangle theory for dice :

When two dice are thrown then the possibility of getting total sum on the top surface of the dice is shown below,

Minimum sum of two dice = $[1,1] = 2$

Maximum sum of two dice = $[6,6] = 12$



Sample Space for a Pack of 52 playing Cards

Total number of cards = 52 (except 2 jokers and one Blank card)

☞ 26 Black suits [13 Spades and 13 Clubs]

☞ 26 Red suits [13 Hearts and 13 Diamonds]

Total number of face cards = 12 (4 Kings, 4 Queens, 4 Jacks)

												Face Cards		
Suits	Ace (A)	2	3	4	5	6	7	8	9	10	Jack	Queen	King	
Club 	Non-Face Cards 4 x 10 = 40 Cards										✓	✓	✓	
Diamond 											✓	✓	✓	
Heart 											✓	✓	✓	
Spades 											✓	✓	✓	
												4 × 3 = 12 Cards		

RANDOM EXPERIMENT :

A random experiment is an experiment or a process for which the outcomes cannot be predicted with certainty.

Example : In an experiment of throwing a dice and getting a number 1, 2, 3, 4, 5 or 6 are different events.

EVENTS :

A set of one or more outcomes of a random experiment is called event.

Types of Events :

1. **Equally Likely Events :** Events are said to be equally likely when the chances are same for occurrence of all events.

Example : When a dice is thrown any one number from 1 to 6 may occur. In this trial, the six events are equally likely.

2. **Mutually Exhaustive Events :** Two or more events in any trial are known as exhaustive events. If one of them is necessarily (must) occurs.

Example : When a dice is thrown, there are six exhaustive events.

3. **Mutually Exclusive Events :** If the occurrence of anyone of the events in a trial prevents the occurrence of the other events, then the events are said to be mutually exclusive events.

Example : When a dice is thrown, the event of getting faces numbered 1 to 6 are mutually exclusive.

Key Point

If A and B both are mutually exclusive events in same sample space then $P(A \cap B) = 0$.

4. **Independent Events :** If there are two or more events such that the occurrence of any one does not depend on occurrence of other, they are said to be independent event.

Example : Throwing two dice, event A is face 4 in first dice and event B is face 3 in second dice, these both events are independent, and also not mutually exclusive because it can happen simultaneously.

Key Point

If A and B both are independent events in different sample space then $P(A \cap B) = P(A)P(B)$.

5. **Dependent Events :** When two events are dependent, the occurrence of one event influences the probability of another event.

Example : Throwing two dice, event A is face 4 in first dice and event B is sum total value 7. The value 4 in first dice gives the information that for total sum 7 it should be 3 in second dice.

Classical Definition of Probability :

In a random experiment, probability is the ratio of favourable events to corresponding sample space. The probability of event E in the sample space S is defined as,

$$P(E) = \frac{\text{Favourable events}}{\text{Total number of events}} = \frac{n(E)}{n(S)}$$

Examples :

- (i) The typical example of classical probability would be fair dice roll because it is equally probable that you will land on any of the six numbers on the die : 1, 2, 3, 4, 5 or 6
- (ii) Throwing a dice, the event A that even number on the dice. Sample space for a dice $S = \{1, 2, 3, 4, 5, 6\}$ elements of event $A = \{2, 4, 6\}$.

$$\text{The required probability, } P(A) = \frac{n(A)}{n(S)} = \frac{3}{6} = \frac{1}{2} = 0.5$$

Conditional Probability :

It gives the probability of happening of any event if another has been already occurred.

$P\left(\frac{E_1}{E_2}\right)$ = Probability of getting the event E_1 when event E_2 has been already occurred.

$$P\left(\frac{E_1}{E_2}\right) = \frac{P(E_1 \cap E_2)}{P(E_2)}$$

Bayes' Theorem :

An event A corresponds to a number of n exhaustive events $B_1, B_2, B_3, \dots, B_n$. If $P(B_i)$ and $P\left(\frac{A}{B_i}\right)$ are given, then

$$P\left(\frac{A}{B_i}\right) = \frac{P(B_i)P\left(\frac{A}{B_i}\right)}{\sum P(B_i)P\left(\frac{A}{B_i}\right)}$$

Key Point**Results of Probability :**

- (i) $0 \leq P(E) \leq 1$
- (ii) $P(\bar{E}) = 1 - P(E)$
- (iii) $P(E_1 \cup E_2) = P(E_1) + P(E_2) - P(E_1 \cap E_2)$ if mutually exclusive then $P(E_1 \cap E_2) = 0$
Therefore, $P(E_1 \cup E_2) = P(E_1) + P(E_2)$
- (iv) $P(E_1 \cup E_2 \cup E_3) = P(E_1) + P(E_2) + P(E_3) - P(E_2 \cap E_3) - P(E_1 \cap E_2) - P(E_1 \cap E_3) + P(E_1 \cap E_2 \cap E_3)$
- (v) $P(\bar{E}_1 \cap \bar{E}_2) = P(\overline{E_1 \cup E_2}) = 1 - P(E_1 \cup E_2)$

PROBABILITY DENSITY FUNCTION :

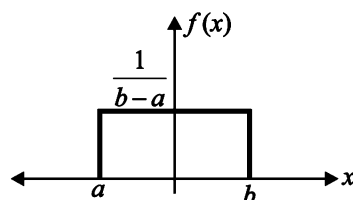
A continuous function $f(x)$ is called a probability density function of a random variable, if it satisfies the following conditions,

- (i) $f(x) \geq 0$
- (ii) $\int_{-\infty}^{\infty} f(x) dx = 1$

PROBABILITY OF DISTRIBUTION :**1. Uniform Distribution**

The probability density function of a uniform random variable on the interval (a, b) is given by,

$$f(x) = \begin{cases} \frac{1}{b-a} & \text{if } a < x < b \\ 0 & \text{otherwise} \end{cases}$$

**Key Point**

(i) Mean $\bar{x} = \frac{a+b}{2}$

(ii) Variance $\sigma^2 = \frac{(b-a)^2}{12}$

(iii) Standard deviation $\sigma = \sqrt{\text{Variance}}$

2. Binomial Distribution

Binomial Distribution gives the probability of happening of event ' r ' times exactly in ' n ' trials

$$P(r) = {}^nC_r p^r q^{n-r}$$

where, n = Number of trials, r = Number of favourable events

p = Probability of happening of event

q = Probability of not happening of event = $1 - p$

Key Point

(i) Mean = np

(ii) Variance = npq

(iii) Standard Deviation = $\sqrt{npq}$

3. Poisson Distribution

Poisson Distribution is a particular limiting form of Binomial distribution when p or q is very small and ' n ' is large enough.

$$P(r) = \frac{m^r e^{-m}}{r!}, \quad r = 0, 1, 2, \dots$$

where, $m = np$, n = Number of trials, p = Success case probability,

r = Number of the success trial

where, m is mean of distribution

Key Point

The expected value (mean) and variance of a Poisson distributed random variable are approximately equal. i.e.

$$\text{Mean} \approx \text{Variance} = m$$

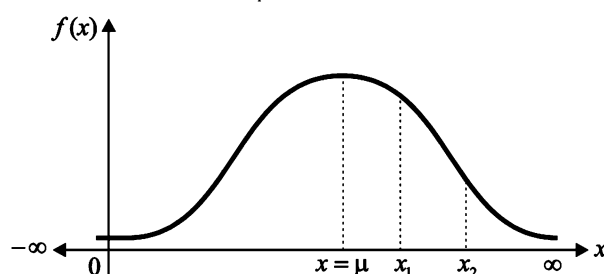
4. Normal Distribution

Normal Distribution is a continuous distribution and it is derived as the limiting form of Binomial Distribution for large values of 'n' and when neither 'p' nor 'q' is very small.

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad \text{where, } \mu = \text{mean, } \sigma = \text{Standard deviation}$$

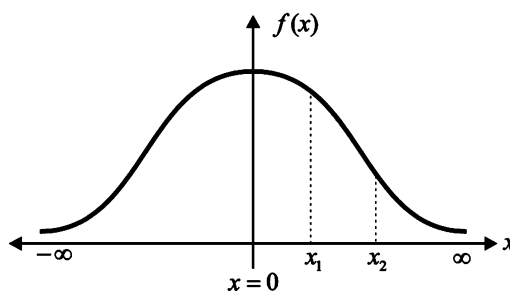
Probability of x lying between x_1 and x_2 is given by the area under normal curve from x_1 and x_2 i.e.

$$P(x_1 \leq x \leq x_2) = \frac{1}{\sigma\sqrt{2\pi}} \int_{x_1}^{x_2} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$



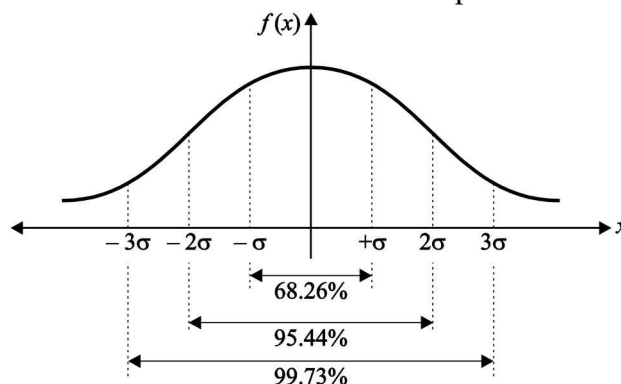
Probability when mean = 0,

$$P(x_1 \leq x \leq x_2) = \frac{1}{\sigma\sqrt{2\pi}} \int_{x_1}^{x_2} e^{-\frac{x^2}{2\sigma^2}} dx$$



Key Point

- (i) Normal distribution is symmetric about its mean
- (ii) It is also referred as Gaussian distribution and bell shaped distribution curve.



EXPONENTIAL DISTRIBUTION :

A continuous random variable x assuming non negative values is said to have exponential distribution with parameter $\lambda > 0$, if its probability density function is given by,

$$f(x) = \begin{cases} \lambda e^{-\lambda x} & \text{for } x \geq 0 \\ 0 & \text{for } x < 0 \end{cases}$$

where, λ is a parameter.

Key Point

(i) Mean = $\frac{1}{\lambda}$	(ii) Variance = $\frac{1}{\lambda^2}$	(iii) Standard deviation = $\frac{1}{\lambda}$
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RANDOM VARIABLES AND STATISTICS :**1. Random Variable :**

A random variable is defined as a real number x connected with the outcomes of a random experiment.

(i) **Discrete random variable :** A real valued function defined on a discrete sample space is called a discrete random variable.

(ii) **Continuous random variable :** A random variable is said to be continuous, if it can take all possible values between certain limits.

Values and Parameters	Types of Random Variables	Formula
Expected Value	Discrete random variable	$E(X) = \sum_{i=1}^n x_i P(x_i)$
	Continuous random variable	$E(X) = \int_{-\infty}^{\infty} x \cdot f(x) dx$
Mean Square Value	Discrete random variable	$E(X^2) = \sum_{i=1}^n x_i^2 P(x_i)$
	Continuous random variable	$E(X^2) = \int_{-\infty}^{\infty} x^2 \cdot f(x) dx$
Variance		$V(X) = \sigma^2 = E[(X - \mu)^2] = E(X^2) - [E(X)]^2$
Statistics, Correlation and Regression		
Standard Deviation		$\sigma_x = \sqrt{\text{Var}(X)} = \sqrt{\frac{\sum (x - \bar{x})^2 f_i}{n}}$
Mean	For ungrouped data	$\bar{x} = \frac{\sum x_i}{n}$
	For grouped data	$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$

Median	For ungrouped data	$\text{Median} = \begin{cases} x_{k+1} & \text{When } n \text{ is odd and } n = 2k + 1 \\ \frac{x_k + x_{k+1}}{2} & \text{When } n \text{ is even and } n = 2k \end{cases}$
	For grouped data	$\text{Median} = L + \left(\frac{\frac{F}{2} - C}{f} \right) K$ where L = Lower limit of the median class F = Total frequency f = Frequency of median class K = Width of median class C = Cumulative frequency up to the class preceding the median class
Mode	For ungrouped data	The mode is the value of the variables which occurs most often.
	For grouped data	$\text{Mode} = l + \left(\frac{F - F_{-1}}{2F - F_1 - F_{-1}} \right) K$ where, l = Lower limit of class containing mode K = Size of modal class or common width of the class F_1 = Frequency after modal class F = Frequency of modal class F_{-1} = Frequency of before modal class
Karl Pearson's Co-efficient of Correlation		$r = \frac{\sum xy}{\sqrt{(\sum x^2 \sum y^2)}}$ where, $x = X - M_x$ = deviation of variable X measured from its mean M_x. $y = Y - M_y$ = deviation of variable Y measured from its mean M_y.
Spearman's formula for Rank Correlation Coefficient		$r = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$ where, d_i = difference in rank of i^{th} individual value n = number of individuals.

Regression	The regression line of x on y	$x - \bar{x} = r \frac{\sigma_x}{\sigma_y} (y - \bar{y})$
	The regression line of y on x	$y - \bar{y} = r \cdot \frac{\sigma_y}{\sigma_x} [x - \bar{x}]$
	Angle between two line of regression	$\tan \theta = \left(\frac{1-r^2}{r} \right) \left(\frac{\sigma_x \cdot \sigma_y}{\sigma_x^2 + \sigma_y^2} \right)$

2. Properties of Expectation

- (i) $E(c) = c$, c is a constant.
- (ii) $E(cX) = cE(X)$, c is a constant.
- (iii) $E(aX + b) = aE(X) + b$, a and b are constants.
- (iv) $E(X + Y) = E(X) + E(Y)$
- (v) $E(X - Y) = E(X) - E(Y)$.

3. Properties of Variance

- (i) $V(c) = 0$, c is a constant.
- (ii) $V(aX) = a^2V(X)$
- (iii) $V(aX \pm b) = V(aX) + V(b) = a^2V(X)$, a and b are constants.
- (iv) $V(aX + bY) = a^2V(X) + b^2V(Y) + 2ab \text{Cov}(X, Y)$

4. Covariance

The measures of the simultaneous variation between the random variable X and Y is called the covariance and written as $\text{Cov}(X, Y)$.

If X and Y are two random variables with respective expected values $E(X)$ and $E(Y)$, then

$$\text{Cov}(X, Y) = E(XY) - E(X)E(Y)$$

Key Point

- (i) Rank of correlation is always less than equal to 1 ($r \leq 1$).
- (ii) Mode = 3 median – 2 mean.
- (iii) The covariance of two independent variable is equal to zero.

Example 1

A box contains 5 black and 5 red balls. Two balls are randomly picked one after another from the box, without replacement. The probability for both balls being red is

Solution :

Given : A box contains 5 black and 5 red balls.

Method 1

Probability of picking out 1 red ball out of 10 balls = $\frac{5}{10}$

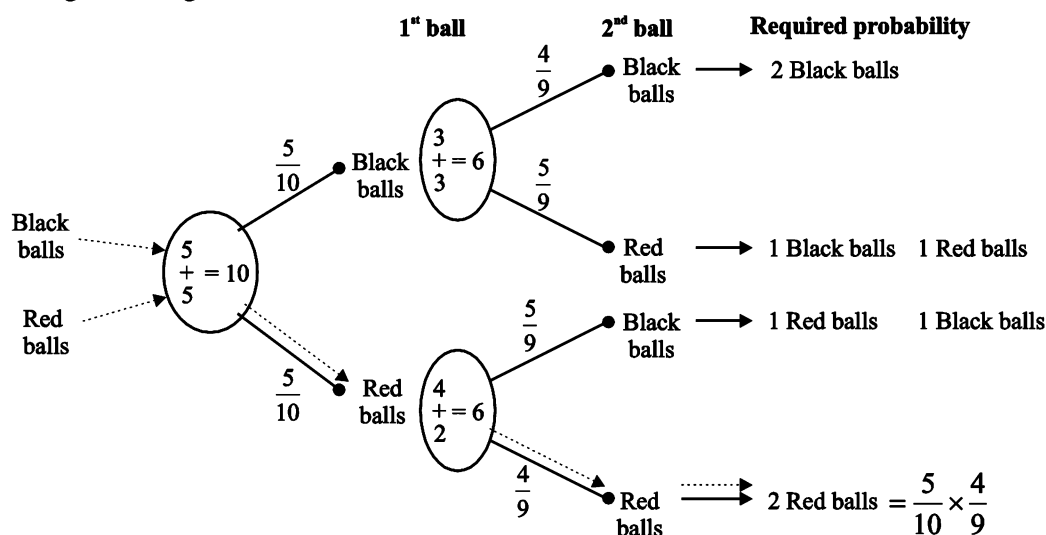
Here the point is to be noted that there is no replacement of balls.

So, probability of drawing two red balls

$$= \frac{5}{10} \times \frac{4}{9} = \frac{2}{9}$$

Method 2

By using tree diagram,



So, probability of drawing two red balls

$$= \frac{5}{10} \times \frac{4}{9} = \frac{2}{9}$$

Example 2

A box contains 5 Sony, 6 Samsung and 4 Sandisk pen drives, 3 pen drives are drawn at random. What is the probability that they are not of the same company?

Solution :

The total number of pen drives = $5 + 6 + 4 = 15$

$$n(S) = {}^{15}C_3 = (15 \times 14 \times 13) / (3 \times 2) = 455$$

Now, 3 pen drives out of 15 pen drives can be drawn in 455 ways.

If all 3 pen drives are of the same company,

It can be done in ${}^5C_3 + {}^6C_3 + {}^4C_3 = 10 + 20 + 4 = 34$ ways

Probability that all 3 pen drives are not of the same company = $1 - \left(\frac{34}{455} \right) = \frac{421}{455}$

Example 3

Marks obtained by 100 students in an examination are given in the table

S. No.	Marks obtained	Number of students
1.	25	20
2.	30	20
3.	35	40
4.	40	20

What would be the mean, median, and mode of the marks obtained by the students?

Solution :

Given :

S. No.	Marks obtained (x_i)	Number of students (f_i)
1.	25	20
2.	30	20
3.	35	40
4.	40	20

$$\text{Mean} = \frac{\sum x_i f_i}{\sum f_i}$$

$$\begin{aligned}\text{Mean} &= \frac{(20 \times 25) + (20 \times 30) + (40 \times 35) + (20 \times 40)}{20 + 20 + 40 + 20} \\ &= \frac{500 + 600 + 1400 + 800}{100} = \frac{3300}{100} = 33\end{aligned}$$

Now the calculation for median, for 100 data (i.e. even)

Median = The average of marks of 50th, 51st observations

$$= \frac{35 + 35}{2} = 35$$

Mode = The marks with highest frequency = 35.



2012 IIT Delhi

- 5.1** *A* and *B* are friends. They decide to meet between 1 PM and 2 PM on a given day. There is a condition that whoever arrives first will not wait for the other for more than 15 minutes. The probability that they will meet on that day is

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) $\frac{1}{4}$ (B) $\frac{1}{16}$
(C) $\frac{7}{16}$ (D) $\frac{9}{16}$
- 5.2** An automobile plant contracted to buy shock absorbers from two suppliers *X* and *Y*. *X* supplies 60% and *Y* supplies 40% of the shock absorbers. All shock absorbers are subjected to a quality test. The ones that pass the quality test are considered reliable. Of *X*'s shock absorbers, 96% are reliable. Of *Y*'s shock absorbers, 72% are reliable. The probability that a randomly chosen shock absorber, which is found to be reliable, is made by *Y* is

[BT, CE, CH, CS, ME, PH, PI]

- (A) 0.288 (B) 0.334
(C) 0.667 (D) 0.720
- 5.3** Two policemen, *A* and *B*, fire once each at the same time at an escaping convict. The probability that *A* hits the convict is three times the probability that *B* hits the convict. If the probability of the convict not getting injured is 0.5, the probability that *B* hits the convict is [AE, AG, MN]
- (A) 0.14 (B) 0.22
(C) 0.33 (D) 0.40

2013 IIT Bombay

- 5.4** What is the chance that a leap year, selected at random, will contain 53 Saturdays? [EC, EE, IN]

(A) $\frac{2}{7}$ (B) $\frac{3}{7}$

(C) $\frac{1}{7}$ (D) $\frac{5}{7}$

- 5.5** In a factory, two machines *M1* and *M2* manufactures 60% and 40% of the autocomponents respectively. Out of the total production, 2% of *M1* and 3% of *M2* are found to be defective. If a randomly drawn autocomponent from the combined lot is found defective, what is the probability that it was manufactured by *M2*?

[AE, AG, BT, CH, CY, MN, XE, XL]

(A) 0.35 (B) 0.45
(C) 0.5 (D) 0.4

- 5.6** Out of all the 2-digit integers between 1 and 100, a 2-digit number has to be selected at random. What is probability that the selected number is not divisible by 7? [CS, ME, PI]

(A) $\frac{13}{90}$ (B) $\frac{12}{90}$
(C) $\frac{78}{90}$ (D) $\frac{77}{90}$

2014 IIT Kharagpur

- 5.7** You are given three coins : one has heads on both faces, the second has tails on both faces, and the third has a head on one face and a tail on the other. You choose a coin at random and toss it, and it comes up heads. The probability that the other face is tails is [EC-1, ME-1]

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$
(C) $\frac{1}{2}$ (D) $\frac{2}{3}$

- 5.8** A regular die has six sides with numbers 1 to 6 marked on its sides. If a very large number of throws show the following frequencies of occurrence :

$1 \rightarrow 0.167$; $2 \rightarrow 0.167$; $3 \rightarrow 0.152$;
 $4 \rightarrow 0.166$; $5 \rightarrow 0.168$; $6 \rightarrow 0.180$.

We call this die [EC-2, ME-2]

- (A) irregular (B) biased
 (C) Gaussian (D) insufficient

- 5.9 A batch of one hundred bulbs is inspected by testing four randomly chosen bulbs. The batch is rejected if even one of the bulbs is defective. A batch typically has five defective bulbs. The probability that the current batch is accepted is _____. [EC-3, ME-3]

- 5.10 In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is _____ years.

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

- 5.11 10% of the population in a town is HIV+. A new diagnostic kit for HIV detection is available; this kit correctly identifies HIV+ individuals 95% of the time and HIV- individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is _____.

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

2015 IIT Kanpur

- 5.12 Ram and Ramesh appeared in an interview for two vacancies in the same department. The probability of Ram's selection is $1/6$ and that of Ramesh is $1/8$. What is the probability that only one of them will be selected? [EC-2, ME-1]
- (A) $47/48$ (B) $1/4$
 (C) $13/48$ (D) $35/48$

- 5.13 Given Set $A = \{2, 3, 4, 5\}$ and Set $B = \{11, 12, 13, 14, 15\}$, two numbers are randomly selected, one from each set. What is the probability that the sum of the two numbers equals 16?

[CS-1, EE-1]

- (A) 0.20 (B) 0.25
 (C) 0.30 (D) 0.33

- 5.14 The probabilities that a student passes in Mathematics, Physics and Chemistry are m , p and c respectively. Of these subjects, the student has 75% chance of passing in at least one, a 50% chance of passing in at least two and a 40% chance of passing in exactly two.

Following relations are drawn in m, p, c :

- I. $p + m + c = 27/20$
 II. $p + m + c = 13/20$
 III. $(p) \times (m) \times (c) = 1/10$ [CS-1, EE-1]

- (A) Only relation I is true
 (B) Only relation II is true
 (C) Relations II and III are true
 (D) Relations I and III are true

- 5.15 A coin tossed thrice. Let X be the event that head occurs in each of the first two tosses. Let Y be the event that a tail occurs on the third toss. Let Z be the event that two tails occurs in three tosses. Based on the above information, which one of the following statements is TRUE?

[AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]

- (A) X and Y are not independent
 (B) Y and Z are dependent
 (C) Y and Z are independent
 (D) X and Z are independent

- 5.16 Four cards are randomly selected from a pack of 52 cards. If the first two cards are kings, what is the probability that the third card is a king? [CE-2]

- (A) $\frac{4}{52}$
 (B) $\frac{2}{50}$
 (C) $\frac{1}{52} \times \left(\frac{1}{52}\right)$
 (D) $\frac{1}{52} \times \left(\frac{1}{52}\right) \times \left(\frac{1}{50}\right)$

2016 IISc Bangalore

- 5.17** A person moving through a tuberculosis prone zone has a 50% probability of becoming infected. However, only 30% of infected people develop the disease. What percentage of people moving through a tuberculosis prone zone remains infected but does not show symptoms of disease? **[EC-1, ME-1]**

- (A) 15 (B) 33
 (C) 35 (D) 37

- 5.18** Shaquille O' Neal is a 60% career free throw shooter, meaning that he successfully makes 60 free throws out of 100 attempts on average. What is the probability that he will successfully make exactly 6 free throws in 10 attempts?

[AE, EE-2, TF, XE, XL]

- (A) 0.2508 (B) 0.2816
 (C) 0.2934 (D) 0.6000

- 5.19** Students taking an exam are divided into two groups, P and Q such that each group has the same number of students. The performance of each of the students in a test was evaluated out of 200 marks. It was observed that the mean of group P was 105, while that of group Q was 85. The standard deviation of group P was 25, while that of group Q was 5. Assuming that the marks were distributed

on a normal distribution, which of the following statements will have the highest probability of being **TRUE**?

[BT, CH, GG, ME-2, MN, PH]

- (A) No student in group Q scored less marks than any student in group P .
 (B) No student in group P scored less marks than any student in group Q .
 (C) Most students of group Q scored marks in a narrower range than students in group P .
 (D) The median of the marks of group P is 100.

2017 IIT Roorkee

- 5.20** Two dices are thrown simultaneously. The probability that the product of the numbers appearing on the top faces of the dice is a perfect square is

[CE-2, IN, XE, XL]

- (A) $\frac{1}{9}$ (B) $\frac{2}{9}$
 (C) $\frac{1}{3}$ (D) $\frac{4}{9}$

- 5.21** A couple has 2 children. The probability that both children are boys if the older is a boy is **[AG, GG, ME-2]**

- (A) $\frac{1}{4}$ (B) $\frac{1}{3}$
 (C) $\frac{1}{2}$ (D) 1

2018 IIT Guwahati

- 5.22** A cab was involved in a hit and run accident at night. You are given the following data about the cabs in the city and the accident.

- (i) 85% of cabs in the city are green and the remaining cabs are blue.
 (ii) A witness identified the cab involved in the accident as blue.

(iii) It is known that a witness can correctly identify the cab colour only 80% of the time.

Which of the following options is closest to the probability that the accident was caused by a blue cab? [EC]

- (A) 12% (B) 15%
(C) 41% (D) 80%

5.23 A class of twelve children has two more boys than girls. A group of three children are randomly picked from this class to accompany the teacher on a field trip. What is the probability that the group accompanying the teacher contains more girls than boys? [EE]

- (A) 0 (B) $\frac{325}{864}$
(C) $\frac{525}{864}$ (D) $\frac{5}{12}$

5.24 An unbiased coin is tossed six times in a row and four different such trials are conducted. One trial implies six tosses of the coin. If H stands for head and T stands for tail, the following are the observations from the four trials :

- (1) $HTHTHT$ (2) $TTHHHT$
(3) $HTTHHT$ (4) $HHHT\_ \_$

Which statement describing the last two coin tosses of the fourth trial has the higher probability of being correct?

[AE, MA, ME-2, PI]

- (A) Two T will occur
(B) One H and one T will occur
(C) Two H will occur
(D) One H will be followed by one T .

5.25 A six sided unbiased die with four green faces and two red faces is rolled seven times. Which of the following combinations is the most likely outcome of the experiment? [CS, MN]

- (A) Three green faces and four red faces.
(B) Four green faces and three red faces.
(C) Five green faces and two red faces.
(D) Six green faces and one red face.

2020 IIT Delhi

5.26 If P, Q, R, S are 4 individuals, how many teams of size exceeding one can be formed, with Q as a member?

[EE, EY, TF]

- (A) 5 (B) 7
(C) 8 (D) 6

2021 IIT Bombay

5.27 Let X is a continuous random variable denoting the temperature measured. The range of Temperature is $[0, 100]$ degree Celsius and let the probability density function of X be $f(x) = 0.01$ for $0 \leq X \leq 100$. The mean of X is _____.

[AG, EE, EY, GG]

- (A) 50 (B) 2.5
(C) 5 (D) 25

5.28 A function $\lambda(p, q)$ is defined by

$$\lambda(p, q) = \begin{cases} (p-q)^2, & \text{if } p \geq q \\ p+q & \text{if } p < q \end{cases}$$

The value of expression

$$\frac{\lambda[-(-3+2), (-2+3)]}{[-(-2+1)]} \text{ is}$$

[CE-1, CY, IN]

- (A) 0 (B) $\frac{16}{3}$
(C) 16 (D) -1

5.29 Two identical cube shaped dice each with faces numbered 1 to 6 are rolled simultaneously. The probability that an even number is rolled out on each dice is

[AE, AR, BM, CE-2, MN, PH]

(A) $\frac{1}{4}$ (B) $\frac{1}{12}$

(C) $\frac{1}{8}$ (D) $\frac{1}{36}$

- 5.30** A box contains 15 blue balls and 45 black balls. If 2 balls are selected randomly, without replacement, the probability of an outcome in which the first selected is a blue ball and the second selected is a black ball, is _____. [ME-2, MT]

(A) $\frac{3}{16}$ (B) $\frac{45}{236}$
(C) $\frac{3}{4}$ (D) $\frac{1}{4}$

- 5.31** There are five bags each containing identical sets of ten distinct chocolates. One chocolate is picked from each bag. The probability that at least two chocolates are identical is_____.

[BT, CH, CS-1, MA, TF]

(A) 0.8125 (B) 0.6976
(C) 0.3024 (D) 0.4235

2022 IIT Kharagpur

- 5.32** A function $y(x)$ is defined in the interval $[0, 1]$ on the x -axis as

$$y(x) = \begin{cases} 2 & \text{if } 0 \leq x \leq \frac{1}{3} \\ 3 & \text{if } \frac{1}{3} \leq x \leq \frac{3}{4} \\ 1 & \text{if } \frac{3}{4} \leq x \leq 1 \end{cases}$$

Which one of the following is the area under the curve for the interval $[0, 1]$ on the x -axis?

[CSE]

(A) $\frac{13}{6}$ (B) $\frac{6}{5}$
(C) $\frac{6}{13}$ (D) $\frac{5}{6}$

- 5.33** In a currently conducted National Entrance Test, Boys constituted 65% of those who appeared for the test. Girls constituted the remaining candidates and they accounted for 60% of the qualified candidates. Which one of the following is the correct logical inference based on the information provided in the above passage?

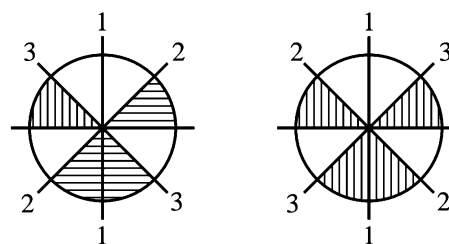
[CSE]

- (A) Equal number of boys and girls appeared for the test
(B) The number of boys who qualified the test is less than the number of girls who qualified.
(C) The number of boys who appeared for the test is less than the number of girls who appeared.
(D) Equal number of boys and girls qualified.

- 5.34** The figure below shows the front and rear view of a disc, which is shaded with identical patterns. The disc is flipped once with respect to any one of the fixed axes 1-1, 2-2 or 3-3 chosen uniformly at random.

What is the probability that the disc DOES NOT retain the same front and rear views after the flipping operation?

[EE]



Front view

Rear view

(A) 1 (B) 0
(C) $\frac{2}{3}$ (D) $\frac{1}{3}$

2023 IIT Kanpur

- 5.35 $f(x)$ and $g(y)$ are functions of x and y , respectively, and $f(x) = g(y)$ for all real values of x and y . Which one of the following options is necessarily TRUE for all x and y ?

[CSE]

- (A) $f(x) = 0$ and $g(y) = 0$
 (B) $f(x) = g(y) = \text{constant}$
 (C) $f(x) \neq \text{constant}$ and $g(y) \neq \text{constant}$
 (D) $f(x) + g(y) = f(x) - g(y)$

- 5.36 How many pairs of sets (S, T) are possible among the subsets of $\{1, 2, 3, 4, 5, 6\}$ that satisfy the condition that S is subset of T ?

[ME]

- (A) 729 (B) 728
 (C) 665 (D) 664

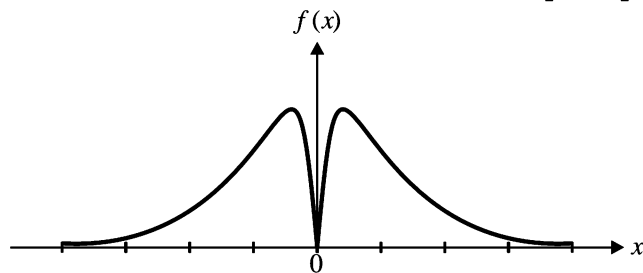
- 5.37 Given a fair six-faced dice where the faces are labelled 1, 2, 3, 4, 5 and 6. What is the probability of getting a “1” on the first roll of dice and the “4” on the second roll?

[EE]

- (A) $\frac{1}{36}$ (B) $\frac{1}{6}$
 (C) $\frac{5}{6}$ (D) $\frac{1}{3}$

- 5.38 Which one of the following options represents the given graph?

[ECE]



- (A) $f(x) = x^2 2^{-|x|}$ (B) $f(x) = x 2^{-|x|}$
 (C) $f(x) = |x| 2^{-x}$ (D) $f(x) = x 2^{-x}$

- 5.39 Which one among the following statements must be TRUE about the mean and the median of the scores of all candidates appearing for GATE 2023?

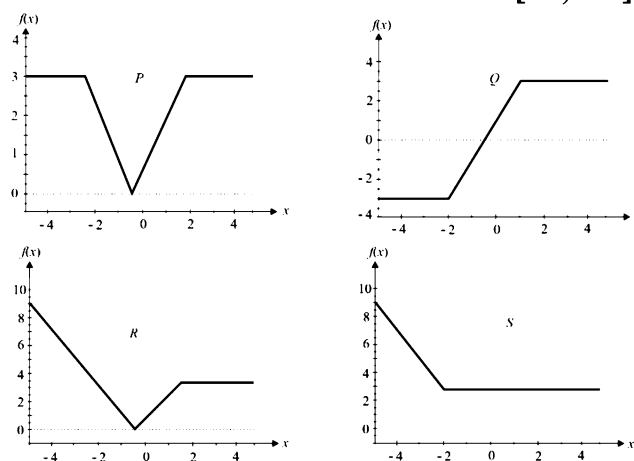
[IN, XE]

- (A) The median is at least as large as the mean.
 (B) The mean is at least as large as the median.
 (C) At most half the candidates have score that is larger than the median.
 (D) At most half the candidates have a score that is larger than the mean.

- 5.40 Which one of the given figures P , Q , R and S represents the graph of the following function?

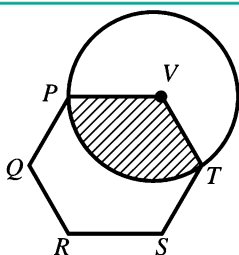
$$f(x) = ||x + 2| - |x - 1||$$

[IN, XE]



- (A) P (B) Q
 (C) R (D) S

- 5.41 In the given figure, PQRSTV is a regular hexagon with each side of length 5 cm. A circle is drawn with its centre at V such that it passes through P. What is the area (in cm^2) of the shaded region? (The diagram is representative)



[CE-1]

- (A) $\frac{25\pi}{3}$ (B) $\frac{20\pi}{3}$
(C) 6π (D) 7π

- 5.42** There are 4 red, 5 green, and 6 blue balls inside a box. If N number of balls are picked simultaneously, what is the smallest value of N that guarantees there will be at least two balls of the same colour?

One cannot see the colour of the balls until they are picked.

[CE-2]

- (A) 4 (B) 15
(C) 5 (D) 2

- 5.43** The coefficient of x^4 in the polynomial $(x-1)^3(x-2)^3$ is equal to _____.

[CH, PI]

- (A) 33 (B) -3
(C) 30 (D) 21

2024 IISc Bangalore

- 5.44** Take two long dice (rectangular parallelepiped), each having four rectangular faces labelled as 2, 3, 5, and 7. If thrown, the long dice cannot land on the square faces and has $1/4$ probability of landing on any of the four rectangular faces. The label on the top face of the dice is the score of the throw. If thrown together, what is the probability of getting the sum of the two long dice scores greater than 11?

- (A) $3/8$ (B) $1/8$
(C) $1/16$ (D) $3/16$

[ME]

- 5.45** Consider the following sample of numbers :

9, 18, 11, 14, 15, 17, 10, 69, 11, 13

The median of the sample is

- (A) 13.5 (B) 14
(C) 11 (D) 18.7

[CS-1]

- 5.46** The probability of a boy or a girl being born is $1/2$. For a family having only three children, what is the probability of having two girls and one boy ?

- (A) $\frac{3}{8}$ (B) $\frac{1}{8}$
(C) $\frac{1}{4}$ (D) $\frac{1}{2}$

[PI, DA]

2025 IIT Roorkee

- 5.47** P and Q play chess frequently against each other. Of these matches, P has won 80% of the matches, drawn 15% of the matches and lost 5% of the matches.

If they play 3 more matches, what is the probability of P winning exactly 2 of these 3 matches?

[ME, PE]

- (A) $\frac{48}{125}$ (B) $\frac{16}{125}$
(C) $\frac{16}{25}$ (D) $\frac{25}{48}$

- 5.48** A final year student appears for placement interview in two companies, S and T. Based on her interview performance, she estimates the probability of receiving job offers from companies S and T to be 0.8 and 0.6, respectively. Let p be the probability that she receives job offers from both the companies. Select the most appropriate option.

[ME, PE]

- (A) $0 \leq p \leq 0.2$ (B) $0.4 \leq p \leq 0.6$
 (C) $0.2 \leq p \leq 0.4$ (D) $0.6 \leq p \leq 1.0$
- 5.49** A fair six-faced dice, with the faces labelled '1', '2', '3', '4', '5', and '6', is rolled thrice. What is the probability of rolling '6' exactly once? [CS-1]
- (A) $\frac{75}{216}$ (B) $\frac{1}{6}$
 (C) $\frac{1}{18}$ (D) $\frac{25}{216}$

2026 IIT Guwahati

- 5.50** Consider a knock-out women's badminton singles tournament where there are no ties. The loser in each game is eliminated from the tournament. Every player plays until she is defeated or remains the last undefeated player. The last undefeated player is declared the winner of the tournament. If there are 64 players in the beginning of the tournament, how many games should be played in total to declare the winner of the tournament? [CS-1]
- (A) 127 (B) 64
 (C) 63 (D) 32
- 5.51** A student needs to enroll for a minimum of 60 credits. A student cannot enroll for more than 70 credits. The credits are divided amongst project and three distinct sets of courses namely, core courses, specialization courses, and elective courses. It is compulsory for a student to enroll for exactly 15 credits of core courses and exactly 20 credits of project. In addition, a student has to enroll for a minimum of 10 credits of specialization courses. The maximum credits of elective courses that a student can enroll for is _____. [CS-1]

- (A) 10 (B) 15
 (C) 20 (D) 25
- 5.52** An unbiased six-faced dice whose faces are marked with numbers 1, 2, 3, 4, 5, and 6 is rolled twice in succession and the number on the top face is recorded each time. The probability that the number appearing in the second roll is an integer multiple of the number appearing in the first roll is [CS-1]
- (A) $\frac{1}{6}$ (B) $\frac{5}{18}$
 (C) $\frac{7}{18}$ (D) $\frac{5}{6}$
- 5.53** In a group of students, 10 students like Mathematics, 12 students like English, 4 students like both Mathematics and English, and 6 students like neither Mathematics nor English. The number of students in the group is _____. [CH]
- (A) 18 (B) 20
 (C) 24 (D) 32
- 5.54** A day can only be cloudy or sunny. The probability of a day being cloudy is 0.5, independent of the condition on other days. What is the probability that in any given four days, there will be three cloudy days and one sunny day? [CS-2]
- (A) $\frac{1}{4}$ (B) $\frac{3}{4}$
 (C) $\frac{2}{3}$ (D) $\frac{3}{8}$
- 5.55** An unbiased six-faced dice whose faces are marked with numbers 1, 2, 3, 4, 5, and 6 is rolled twice in succession and the number on the top face is recorded each time. The probability that the sum of the two recorded numbers is a prime number is [CS-2]
- (A) $\frac{3}{36}$ (B) $\frac{13}{36}$
 (C) $\frac{15}{36}$ (D) $\frac{19}{36}$

Engineering Services Examination (ESE)

1. A bag contains 4 white and 2 black balls and another bag contains 3 of each colour. A bag is selected at random and a ball is drawn at random from the bag chosen. The probability of the white ball drawn is :

(A) $\frac{1}{3}$ (B) $\frac{1}{4}$
(C) $\frac{5}{12}$ (D) $\frac{7}{12}$

[ESE 2020]

2. Four persons are chosen at random from a group of 3 men, 2 women and 4 children. The chance that exactly 2 of them are children, is

(A) $\frac{2}{9}$ (B) $\frac{4}{5}$
(C) $\frac{7}{12}$ (D) $\frac{10}{21}$

[ESE 2021]

3. A batch of 100 capacitors contains 73 which are within the required tolerance values, 17 which are below the required tolerance values, and the remaining are above the required tolerance values. What is the probability that when randomly selecting a capacitor and then a second capacitor, if both are within the required tolerance values when selecting with replacement?

(A) 0.3319 (B) 0.5329
(C) 0.7239 (D) 0.9249

[ESE 2022]

4. In how many ways can 5 prizes be distributed among 4 candidates when every candidate can take one or more prizes ?

[ESE 2025]

(A) 1024 (B) 625
(C) 600 (D) 120

5. If at a get-together 22 people shake their hands with each other, how many handshakes will take place in all ?

(A) 132 (B) 231
(C) 321 (D) 484

[ESE 2025]

6. What is the expectation of the number of failures preceding the first success in an infinite series of independent trials with constant probability p of success in each trial ?

(A) $\frac{q}{p^2}$ (B) $\frac{q}{p}$
(C) $\frac{q}{1+p}$ (D) $\frac{1}{1-q}$

[ESE 2026]

7. A deck of n numbered cards is thoroughly shuffled and the cards are inserted into n numbered cells one by one. If the card number i falls in the cell i , we count it as a match, otherwise not, then what is the variance of total number of such matches ?

(A) 1 (B) 0
(C) $\frac{1}{2}$ (D) $\frac{3}{4}$

[ESE 2026]

8. Let X_1 and X_2 be two independent random variables having variances k and 4 respectively. If the variance of $Y = 3X_2 - X_1$ is 49, then what is the value of k ?

(A) 7 (B) 13
(C) 9 (D) 11

[ESE 2026]

9. What is the value of $P\left(X + Y < \frac{1}{2}\right)$ for the joint probability density function of X and Y $f(x, y) = 3(x + y)$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq x + y \leq 1$?

(A) $\frac{1}{16}$

(B) $\frac{1}{8}$

(C) $\frac{1}{12}$

(D) $\frac{1}{7}$

[ESE 2026]

10. An unbiased coin is thrown n times. It is desired that the relative frequency of the appearance of heads should lie between 0.49 and 0.51. What is the smallest approximate value of n that will ensure this result with 90% confidence ($z = 1.645$)?

(A) 5648

(B) 6765

(C) 4989

(D) 8785

[ESE 2026]

Answers	Probability & Statistics
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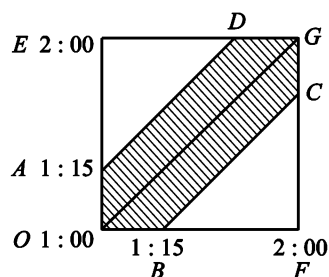
5.1	C	5.2	B	5.3	A	5.4	A	5.5	C
5.6	D	5.7	B	5.8	B	5.9	0.82	5.10	25
5.11	0.4896	5.12	B	5.13	A	5.14	D	5.15	B
5.16	B	5.17	C	5.18	A	5.19	C	5.20	B
5.21	C	5.22	C	5.23	MTA	5.24	B	5.25	C
5.26	B	5.27	A	5.28	A	5.29	A	5.30	B
5.31	B	5.32	A	5.33	B	5.34	C	5.35	B
5.36	A	5.37	A	5.38	A	5.39	C	5.40	A
5.41	A	5.42	A	5.43	A	5.44	D	5.45	A
5.46	A	5.47	A	5.48	B	5.49	A	5.50	C
5.51	D	5.52	C	5.53	C	5.54	A	5.55	C
Engineering Services Examination (ESE)									
1.	D	2.	D	3.	B	4.	A	5.	B
6.	B	7.	A	8.	B	9.	B	10.	B

Explanations	Probability & Statistics
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5.1 (C)

Method 1

OG is the line when both A and B arrive at same time.



Total sample space (area) = $60 \times 60 = 3600$

Favorable cases = Area of OEGF

– (Area of ADE + Area of BCF)

$$= 3600 - 2 \times \left(\frac{1}{2} \times 45 \times 45 \right) = 1575$$

Therefore, the required probability

$$= \frac{1575}{3600} = \frac{7}{16}$$

Hence, the correct option is (C).

Method 2

Total number of ways to arrive for both friends
 $= 60 \times 60 = 3600$

If one friend comes at time 'x' and other comes after 15 min i.e. 'x+15', then they will meet.

If other reaches in x+15 to x+60 i.e. 45 min, then they will not meet.

Therefore, number of ways for them not to meet
 $= 45 \times 45 = 2025$

Number of ways for meeting
 $= 3600 - 2025 = 1575$

Thus, required probability = $\frac{1575}{3600} = \frac{7}{16}$

Hence, the correct option is (C).

5.2 (B)

Given :

- (i) Probability that shock absorbers are supplied by X = 0.6
- (ii) Probability that shock absorbers are supplied by Y = 0.4

(iii) 96% of X 's shock absorbers are reliable
i.e. $= 0.6 \times 0.96$

(iv) 72% of Y 's shock absorbers are reliable
i.e. $= 0.4 \times 0.72$

Method 1

According to Bayes' theorem, the probability that a randomly chosen shock absorber is found to be reliable, is supplied by Y is,

$$P\left(\frac{Y}{R}\right) = \frac{P(Y \cap R)}{P(R)} \quad \dots (i)$$

Where, $P(R)$ = Probability that shock absorber is reliable

$P(R)$ = Reliable when supplied by X

+ Reliable when supplied by Y

$$P(R) = 0.6 \times 0.96 + 0.4 \times 0.72$$

$$P(R) = 0.864 \quad \dots (ii)$$

$P(Y \cap R)$ = Probability that shock absorber is supplied by Y and is reliable

$$P(Y \cap R) = 0.4 \times 0.72 = 0.288 \quad \dots (iii)$$

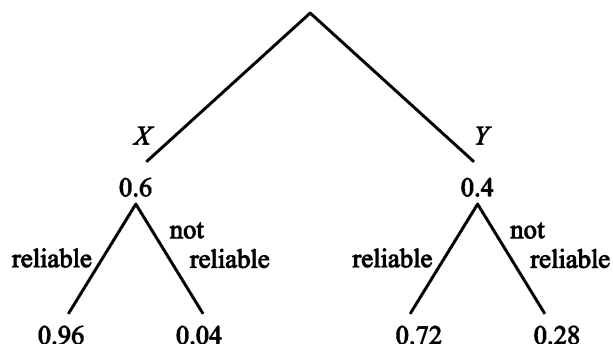
From equations (i), (ii) and (iii),

$$P\left(\frac{Y}{R}\right) = \frac{0.288}{0.864} = 0.334$$

Hence, the correct option is (B).

Method 2

From given information we can draw,



By Bayes' theorem the probability that a randomly chosen shock absorber which is reliable, is made by Y is,

$$= \frac{0.72 \times 0.4}{0.72 \times 0.4 + 0.96 \times 0.6} = 0.33$$

Hence, the correct option is (B).

5.3 (A)**Method 1**

Suppose :

$X = A$ hits the convict

$Y = B$ hits the convict

Given : $P(X) = 3 \times P(Y)$

Z = Convict is injured

Z' = Convict is not injured

Given : $P(Z') = 0.5$

$$P(Z) = 1 - P(Z') = 1 - 0.5 = 0.5$$

$$\text{Now, } P(Z) = P(X) \times P(Y') + P(X') \times P(Y) + P(X) \times P(Y)$$

Let, $P(Y) = t$

$$P(X) = 3t$$

$$P(Y') = 1 - t$$

$$P(X') = 1 - 3t$$

Substituting the values in above equation,

$$0.5 = [3t \times (1 - t)] + [(1 - 3t) \times t] + (3t \times t)$$

$$3t - 3t^2 + t - 3t^2 + 3t^2 = 0.5$$

$$3t^2 - 4t + 0.5 = 0$$

$$6t^2 - 8t + 1 = 0 \quad \dots (i)$$

From equation (i), $t = 1.193$ and 0.1396

Probability cannot be greater than 1 and hence t will be $0.1396 \approx 0.14$.

Hence, the correct option is (A).

Method 2

Given :

$$P(Z') = 0.5$$

Now $P(Z') = [P(X') \times P(Y')]$

$$0.5 = (1 - 3t) \times (1 - t)$$

$$6t^2 - 8t + 1 = 0$$

By solving, $t = 0.14$.

Hence, the correct option is (A).

5.4 (A)

Given : A leap year (366 days).

One week contains only one Sunday.

So, the minimum number of Sundays in a leap year is equal to the number of weeks.

$$\text{Weeks} = \frac{366}{7} = 52\frac{2}{7}$$

This mixed fraction shows that a leap year contains 52 weeks and 2 days.

These 2 days are consecutive and have following possibilities :

Sunday	Monday
Monday	Tuesday
Tuesday	Wednesday
Wednesday	Thursday
Thursday	Friday
Friday	Saturday
Saturday	Sunday

Let, A be the event of occurrence of 53 Sundays.

$$n(S) = 7$$

$$n(A) = 2$$

Required probability is given by,

$$P(A) = \frac{n(A)}{n(S)} = \frac{2}{7}$$

Hence, the correct option is (A).

5.5 (C)

Given :

- (i) Probability that autocomponents are manufactured by $M_1 = 0.6$
2% of autocomponents manufactured by M_1 are defective i.e. $= 0.6 \times 0.02$
- (ii) Probability that autocomponents are manufactured by $M_2 = 0.4$
3% of autocomponents manufactured by M_2 are defective i.e. $= 0.4 \times 0.03$

According to Bayes' theorem, if a component is defective then the probability that it was manufactured by M_2 ,

$$P\left(\frac{M_2}{D}\right) = \frac{P(M_2 \cap D)}{P(D)}$$

Where, $P(D)$ = Defective and produced by M_1

+ Defective and produced by M_2

$$= 0.6 \times 0.02 + 0.4 \times 0.03$$

$$P(D) = 0.024$$

$$P(M_2 \cap D) = \text{Probability of being}$$

defective and manufactured by M_2

$$P(M_2 \cap D) = 0.4 \times 0.03 = 0.012$$

$$\text{So, } P\left(\frac{M_2}{D}\right) = \frac{0.012}{0.024} = 0.5$$

Hence, the correct option is (C).

5.6 (D)

Two digit numbers divisible by 7 are : 14, 21, ...98.

This is a A.P. series. So,

$$T_n = a + (n-1)d$$

$$98 = 14 + (n-1)7$$

$$\frac{84}{7} = (n-1)$$

$$n = 13$$

There are 13 two digit numbers which are divisible by 7 and between 1 to 100, there are 90 two digit numbers.

$$\text{So, } 90 - 13 = 77$$

Therefore, probability that selected number is not divisible by 7 is,

$$P(E) = \frac{77}{90}$$

Hence, the correct option is (D).

5.7 (B)

There are three coins. One coin is selected at random and tossed.

The result of toss is head.

So, the coin is possibly one of the following two coins.

Coin 1 : Head on both sides.

Coin 2 : A head and a tail.

The total possibilities for the other side of selected coin are :

{head, head, tail}

Therefore, $n(S) = 3$

Let A represent the event of occurrence of tail on other side of selected coin.

$$n(A) = 1$$

Required probability is given by,

$$P(A) = \frac{n(A)}{n(S)} = \frac{1}{3}$$

Hence, the correct option is (B).

5.8 (B)

For a very large number of throws, the frequency should be same for unbiased throws and if not same then the dice is biased.

Hence, the correct option is (B).

5.9 0.82

Method 1

Probability of bulb being defective

$$= \frac{5}{100} = 0.05$$

Probability for bulb being non-defective

$$= \frac{95}{100} = 0.95$$

Probability that the batch is accepted

$$= \text{None of the four bulb being defective} \\ = (0.95)^4 = 0.8145$$

Hence, the probability that the batch is accepted is **0.82**.

Method 2

Total number of bulbs = 100

Number of defective bulbs = 5

So, the probability that a randomly selected bulb is defective,

$$q = \frac{5}{100} = 0.05$$

The probability that bulb is not defective,

$$p = 1 - q = 0.95$$

Number of trials $n = 4$

One bulb is defective thus $r = 1$

Using binomial theorem :

$$P(r) = {}^nC_r p^r q^{n-r}$$

$$P(0) = {}^4C_0 (0.05)^0 \times (0.95)^{4-0} = 0.8145$$

Hence, the probability that the batch is accepted is **0.82**.

5.10 25

Given : Probability of an earthquake greater than magnitude 6 in any given year = 0.04

So, the average time between successive occurrences of such earthquakes is given by,

$$T = \frac{1}{P} = \frac{1}{0.04} = 25 \text{ years}$$

Hence, the average time between successive occurrences of such earthquakes is **25 years**.

5.11 0.4896

Given :

Probability of being HIV+ in the town = 0.1.

Probability of being HIV- in the town = 0.9.

Probability that the kit identifies HIV+ correctly = 0.95.

Probability that the kit identifies HIV- correctly = 0.89.

Probability that the kit identifies HIV- incorrectly = 0.11.

Probability that a person is found HIV+ using the diagnostic kit is given by,

$$P(B) = 0.1 \times 0.95 + 0.11 \times 0.9 = 0.194$$

According to Bayes' theorem, the probability that the individual is actually HIV+, when the kit gives positive results,

$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)} = \frac{0.1 \times 0.95}{0.194}$$

$$P\left(\frac{A}{B}\right) = 0.4896$$

Hence, the probability that the individual is actually positive is **0.4896**.

5.12 (B)

The probability that Ram is selected,

$$A = \frac{1}{6}$$

and the probability that Ram is not selected,

$$\bar{A} = 1 - A = 1 - \frac{1}{6} = \frac{5}{6}$$

Similarly, the probabilities of Ramesh's selection and rejection,

$$B = \frac{1}{8}, \bar{B} = (1 - B) = 1 - \frac{1}{8} = \frac{7}{8}$$

The probability that only one of them get selected is given by,

$$P = A \times \bar{B} + \bar{A} \times B$$

$$P = \frac{1}{6} \times \frac{7}{8} + \frac{5}{6} \times \frac{1}{8} = \frac{1}{4}$$

Hence, the correct option is (B).

5.13 (A)

Given : Set $A = \{2, 3, 4, 5\}$ ($n_1 = 4$)

Set $B = \{11, 12, 13, 14, 15\}$ ($n_2 = 5$)

Total number of ways to select two numbers

$$= {}^4C_1 \times {}^5C_1 = 4 \times 5 = 20$$

The below table shows the sum of all 20 combination of elements in sets A and B .

		Set - B				
		11	12	13	14	15
Set - A	2	13	14	15	16	17
	3	14	15	16	17	18
	4	15	16	17	18	19
	5	16	17	18	19	20

Thus, the total number of ways (sum = 16) is 4.

So, the required probability = $\frac{4}{20} = \frac{1}{5} = 0.2$

Hence, the correct option is (A).

5.14 (D)

Given :

Probabilities that a student passes in :

Mathematics = m

Physics = p

Chemistry = c

Probability that student passes in **at least one** is $75\% = 0.75$

$$1 - [\text{Fails in all}] = 0.75$$

$$1 - [\text{Fails in } m \text{ AND fails in } p \text{ AND fails in } c] = 0.75$$

$$1 - [(1-m)(1-p)(1-c)] = 0.75$$

$$(1-m)(1-p)(1-c) = 0.25$$

$$1 - c - m + mc - p + pc + pm - pmc = 0.25$$

$$1 - (p + m + c) + (pc + pm + mc) - pmc = 0.25$$

$$(p + m + c) - (pc + pm + mc) + pmc = 1 - 0.25$$

$$(p + m + c) - (pc + pm + mc) + pmc = 0.75$$

...(i)

Probability that student passing in **at least two** is $50\% = 0.5$

[(Either passes in Physics and Math)

or (Passes in Physics and Chemistry)

or (Passes in Math and Chemistry)]

or (Passes in all) = 0.5

$$[pm(1-c) + pc(1-m) + mc(1-p)] + mpc = 0.5$$

$$pm + pc + mc - 3pmc + pmc = 0.5$$

$$pm + pc + mc = 0.5 + 2pmc \quad \dots(ii)$$

Probability that student passing in **exactly two** is $40\% = 0.4$

$$pm(1-c) + pc(1-m) + mc(1-p) = 0.4$$

$$pm + pc + mc - 3pmc = 0.4$$

$$pm + pc + mc = 0.4 + 3pmc \quad \dots(iii)$$

From equations (ii) and (iii),

$$0.4 + 3pmc = 0.5 + 2pmc$$

$$pmc = 0.1 = \frac{1}{10} \quad \dots(\text{iv})$$

Thus, relation (III) is true.

And also,

$$pc + pm + mc = 0.4 + (0.1 \times 3) = 0.7 \quad \dots(\text{v})$$

From equations (i), (iv) and (v),

$$p + m + c = 0.7 + 0.1 = 0.8$$

$$p + m + c = 1.35 = \frac{27}{20}$$

Thus, relation (I) is also true.

Hence, the correct option is (D).

5.15 (B)

Given : A coin is tossed three times.

Event X consists of occurrence of head in the first two tosses.

Event Y consists of occurrence of tail in the third toss.

Event Z consists of occurrence of two tails in three tosses.

Two events are said to be dependent if occurrence of one event gives information about the occurrence of another events.

If two heads occur in the first two tosses (event X) then it remove the possibility of occurrence of event Z .

Therefore, events X and Z are dependent.

Hence, option (D) is incorrect.

Event Y states that a tail occurs in third toss but does not comment about first and second toss. Therefore, outcome of first and second toss can be any combination of head and tail which will include,

- (i) Occurrence of two heads which means event Y gives some information about event X . Therefore, events X and Y are dependent.

Hence, option (A) is incorrect.

- (ii) Occurrence of one head and one tail i.e. a total of two tails in three tosses which means event Y gives some information about event Z .

Therefore, event Y and Z are dependent.

Hence, the correct option is (B).

5.16 (B)

Given : Four cards are selected randomly, two of which are kings.

Number of cards left = 50

Number of kings left = 2

Probability that third card is a king = $\frac{2}{50}$

Hence, the correct option is (B).

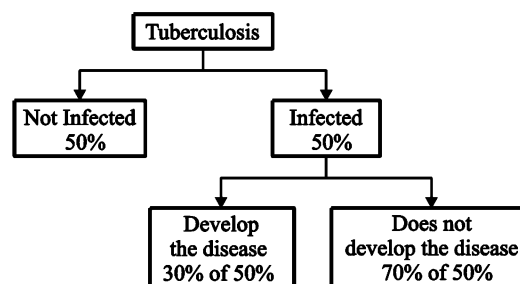
5.17 (C)

Given :

Probability of becoming infected = 50%

Probability of infected people developed the disease = 30%

According to the question, following information can be obtained.



Therefore, percentage of people moving through a tuberculosis prone zone remains infected but does not show symptoms of disease

$$= \frac{70}{100} \times \frac{50}{100} = \frac{35}{100} = 35\%$$

Hence, the correct option is (C).

5.18 (A)

Given :

Probability of Shaquille O' Neal makes successful throw :

$$p = 0.6$$

Probability of Shaquille O' Neal makes unsuccessful throw :

$$q = 1 - p = 0.4$$

Number of attempts ' n ' = 10

Free throws successfully ' x ' = 6

Free throws unsuccessfully = $n - x$

Probability that he will successfully make exactly 6 free throws in 10 attempts

$$P = {}^nC_x p^x \cdot q^{n-x} \quad [q = 1 - p]$$

$$P = {}^{10}C_6 \times (0.6)^6 \times (0.4)^4$$

$$P = \frac{10!}{6!4!} \times (0.6)^6 \times (0.4)^4 = 0.2508$$

Hence, the correct option is (A).

5.19 (C)

Given : Mean of $P = 105$, standard deviation of $P = 25$

Mean of $Q = 85$, standard deviation of $Q = 5$

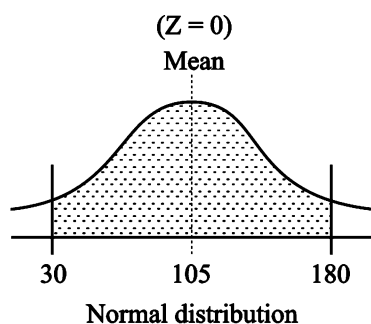
Maximum marks of group

$$P = \mu + 3\sigma = 180$$

Minimum marks of group

$$P = \mu - 3\sigma = 30$$

$$\text{Range} = 180 - 30 = 150$$



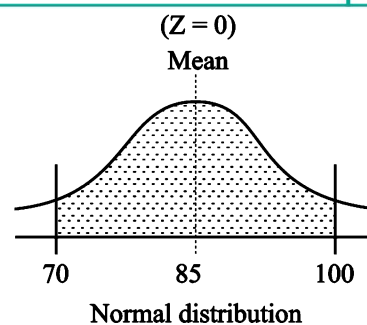
Similarly for ' Q ',

$$\text{Maximum marks} = \mu + 3\sigma = 85 + 15 = 100$$

$$\text{Minimum marks} = \mu - 3\sigma = 85 - 15 = 70$$

$$\text{Range} = 100 - 70 = 30$$

From below figures, it is clear that most students of group Q scored marks in a narrower range than students in group P .



Hence, the correct option is (C).

5.20 (B)

When two dices are thrown simultaneously, the total number of combinations of the number that will be shown on faces of both the dices is given by,

(1, 1) (1, 2) (1, 3) **(1, 4)** (1, 5) (1, 6)
 (2, 1) **(2, 2)** (2, 3) (2, 4) (2, 5) (2, 6)
 (3, 1) (3, 2) **(3, 3)** (3, 4) (3, 5) (3, 6)
(4, 1) (4, 2) (4, 3) **(4, 4)** (4, 5) (4, 6)
 (5, 1) (5, 2) (5, 3) (5, 4) **(5, 5)** (5, 6)
 (6, 1) (6, 2) (6, 3) (6, 4) (6, 5) **(6, 6)**

The combinations that are bold shows the numbers whose product will give perfect square. Therefore, the required probability is given by,

$$P(A) = \frac{8}{36} = \frac{2}{9}$$

Hence, the correct option is (B).

5.21 (C)

Given : Couple has 2 children.

If older kid is a boy then younger kid can be either girl or boy with equal probability.

So, if one kid is a boy, the probability that other kid will be a boy = $\frac{1}{2}$

Hence, the correct option is (C).

5.22 (C)

Given : 85% of the cabs are green

15% are blue

Assuming there are 100 cabs. 85 cabs are green and 15 are blue.

Witness is correct 80% of the times in identifying the cab is blue.

Total number of blue cabs identified correctly
 $= 15 \times 0.8 = 12$

Witness is incorrect 20% of the times identifying the cab is green.

Total number of green cabs identified incorrectly
 $= 85 \times 0.2 = 17$

The total cabs identified by the witness
 $= 12 + 17 = 29$

The probability of identifying blue cab correctly
 $= \frac{12}{29} = 41.3\%$

Hence, the correct option is (C).

5.23 MTA (Marks to all)

Given : Total children = 12

Here boys are two more than girls hence,

Boy (B) = 7 and Girl (G) = 5

Now three children are randomly picked.

Hence, Total combination,

$$N = {}^nC_r = \frac{n!}{r!(n-r)!}$$

$$N = {}^{12}C_3 = \frac{12!}{3!(12-3)!} = 220$$

In the group, if girls are more than boys, then we have possible combinations :

(i) 2 Girls, 1 Boy $\rightarrow N_1 = {}^5C_2 \times {}^7C_1 = 70$

(ii) 3 Girls, 0 Boy $\rightarrow N_2 = {}^5C_3 \times {}^7C_0 = 10$

Therefore, the probability

$$(P) = \frac{N_1 + N_2}{N} = \frac{70 + 10}{220} = \frac{4}{11}$$

Note : The given options are not correct as the right answer for this question is $\frac{4}{11}$.

So, IIT gave **marks to all** for this question.

5.24 (B)

Given :

- (i) Four trials are performed.
- (ii) Each trial consist of six tosses.
- (iii) Output of all the trials are as shown below,

H T H T H T

T T H H H T

H T T H H T

H H H T --

Output of last two coin tosses can be as shown below,

(i) *H T*

(ii) *T H*

(iii) *H H*

(iv) *T T*

From option (A) : Two *T* will occur.

$$\text{Probability} = P(T, T) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

From option (C) : Two *H* will occur.

$$\text{Probability} = P(H, H) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

From option (D) : One *H* will be followed by one *T*

$$\text{Probability} = P(H, T) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

From option (B) : One *H* and one *T* will occur.

$$\text{Probability} = P(H, T) + P(T, H)$$

$$= \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \\ = \frac{1}{2}$$

Therefore, it is clear that last two coin tosses of the fourth trial that has higher probability of being correct is one head and one tail.

Hence, the correct option is (B).

5.25 (C)**Given :** Number of green faces = 4

Number of red faces = 2

$$P(G) = \frac{4}{6} = \frac{2}{3}$$

$$P(R) = \frac{2}{6} = \frac{1}{3}$$

Checking each options and maximum of them will be correct answer.

For option (A) :

$$P(G=3) = {}^7C_3 \left(\frac{2}{3}\right)^3 \times \left(\frac{1}{3}\right)^4 = \frac{35 \times 8}{(3)^7}$$

For option (B) :

$$P(G=4) = {}^7C_4 \left(\frac{2}{3}\right)^4 \times \left(\frac{1}{3}\right)^3 = \frac{35 \times 16}{(3)^7}$$

For option (C) :

$$P(G=5) = {}^7C_5 \left(\frac{2}{3}\right)^5 \times \left(\frac{1}{3}\right)^2 = \frac{42 \times 16}{(3)^7}$$

For option (D) :

$$P(G=6) = {}^7C_6 \left(\frac{2}{3}\right)^6 \times \left(\frac{1}{3}\right)^1 = \frac{28 \times 16}{(3)^7}$$

Option (C) is maximum among all.

Hence, the correct option is (C).

5.26 (B)

Number of available players = 4

Number of teams of 2 members, including Q

$$= QP, QR, QS = 03$$

[No. of ways to fill 1 place by 3 members]

Number of teams of 3 members including Q

= Number of ways of filling 2 places from 3 members

$$= {}^3C_2 = \frac{3!}{2!1!} = \frac{3 \times 2 \times 1}{2 \times 1} = 3$$

Number of teams of 4 members including Q

= Number of ways of filling 3 places from 3 members

$$= {}^3C_3 = \frac{3!}{3!0!} = 1$$

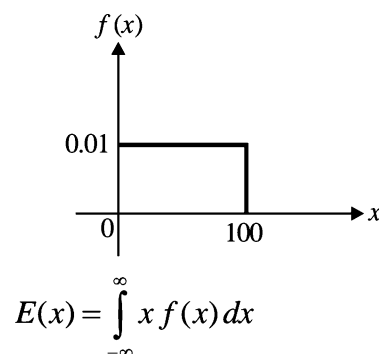
∴ Total number of teams = 3 + 3 + 1 = 7

Hence, the correct option is (B)

5.27 (A)**Given :**

Probability density function of x,

$$\text{PDF } f(x) = 0.01; \quad 0 \leq x \leq 100$$



Here, it is uniform probability distribution,

$$E(x) = \frac{0+100}{2} = 50$$

Hence, the correct option is (A).

5.28 (A)**Given :**

$$\frac{\lambda[-(-3+2), (-2+3)]}{-(-2+1)} = \frac{\lambda(1, 1)}{1} = \lambda(1, 1)$$

Here, $p = q = 1$ Therefore, $\lambda(1, 1) = (1-1)^2 = 0$

Hence, the correct option is (A).

5.29 (A)**Given :**

In the given dice even numbers on the faces are 2, 4, 6 and odd numbers on the faces are 1, 3, 5

So, the probability that an even number is rolled out on each dice will be

 E_1 : occurrence of even number on first dice

$$P(E_1) = \frac{3}{6} = \frac{1}{2}$$

E_2 : occurrence of even number on second dice

$$P(E_2) = \frac{3}{6} = \frac{1}{2}$$

Since, occurrence of even number on second dice is independent of occurrence of even number on first dice.

$$P(E_1 \cap E_2) = P(E_1) \times P(E_2) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

Hence, the correct option is (A).

5.30 (B)

Given :

Blue ball = 15, black ball = 45

Total ball = 15 + 45 = 60

The probability of an outcome in which the first selected is a blue ball and the second selected is a black ball, is

$$\Rightarrow \frac{\text{Total blue ball}}{\text{Total ball}} \times \frac{\text{Total black ball}}{\text{Total ball} - 1}$$

$$\Rightarrow \frac{15}{60} \times \frac{45}{59} = \frac{45}{236}$$

Hence, the correct option is (B).

5.31 (B)

$P(\text{No two chocolates are identical})$

$$= \frac{10 \times 9 \times 8 \times 7 \times 6}{10^5} = \frac{30240}{10^5} = 0.3024$$

$P(\text{At least two chocolates are identical})$

$$= 1 - P(\text{No two chocolates are identical})$$

$$= 1 - 0.3024 = 0.6976$$

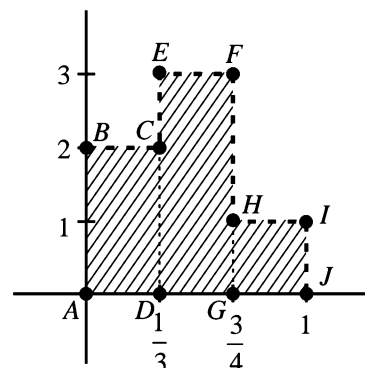
Hence, the correct option is (B).

5.32 (A)

Given : A function $y(x)$ is defined in the interval $[0, 1]$ on the x -axis as

$$y(x) = \begin{cases} 2 & \text{if } 0 \leq x \leq \frac{1}{3} \\ 3 & \text{if } \frac{1}{3} \leq x \leq \frac{3}{4} \\ 1 & \text{if } \frac{3}{4} \leq x \leq 1 \end{cases}$$

Graph of $y(x)$ Versus x , is drawn as shown below figure,



The Area under the curve for the interval $[0, 1]$ on the x -axis will be defined as

$$= \text{Area of } ABCD + \text{Area of } DEFG + \text{Area of } GHJI$$

Area of the rectangle = Length $\times$ Breadth

$$= 2 \times \left(\frac{1}{3}\right) + 3 \times \left(\frac{3}{4} - \frac{1}{3}\right) + 1 \times \left(1 - \frac{3}{4}\right)$$

$$= \frac{2}{3} + \frac{15}{12} + \frac{1}{4} = \frac{2}{3} + \frac{3}{2} = \frac{13}{6}$$

Hence, the correct option is (A).

5.33 (B)

Given : In a currently conducted National Entrance Test,

Percentage of boys who appeared for the test is 65%

Percentage of girls who appeared for the test is $100\% - 65\% = 35\%$

Percentage of qualified girls is 60% of appeared girls.

Accounted percentage of total qualified boys and girls is equals to appeared percentage of girls.

Let, the number of students is x ,

Number of boys appeared for the test is $0.65x$

Number of girls appeared for the test is $0.35x$

Number of qualified girls,

$$= 0.35x \times \frac{3}{5} = 0.21x$$

Number of qualified boys,

$$= 0.35x - 0.21x = 0.14x$$

So, the number of boys who qualified the test is less than the number of girls who qualified.

Hence, the correct option is (B).

5.34 (C)

If we rotate the disc along 1-1 axis,

We get front as rear and rear as front

That means this is not our favorable outcome.

If we rotated the disc along 2-2 axis,

We do not get front as rear and rear as front.

That means disc does not retain the same and this is our favorable outcome.

If we rotated the disc along 3-3 axis,

We do not get front as rear and rear as front.

That means disc does not retain the same and this is also our favorable outcome.

After the flipping operation the probability that the disc does not retain the same front and rear view is

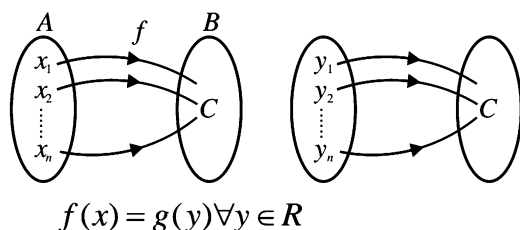
$$P(E) = \frac{\text{Favorable outcomes}}{\text{Total outcomes}} = \frac{2}{3}$$

Hence, the correct option is (C).

5.35 (B)

Given : $f(x)$ and $g(x)$ are functions of x and y and $f(x) = g(y)$ for all real values of x and y .

Here, for all values of x and y it is necessary that image of ' x ' under f is same as image at ' y ' is same as image of ' y ' using ' g ' for all real values of x and y i.e. $f(x) = g(y) = \text{Constant}$



Hence, the correct option is (B).

5.36 (A)

Given : Let two number be (5, 6)

$$T = \phi \quad S = \phi \quad - 1$$

$$T = 5 \quad S = \phi, 5 \quad - 2$$

$$T = 6 \quad S = \phi, 6 \quad - 2$$

$$T = 5, 6 \quad S = \phi, 5, 6 \quad - 3$$

Here, we get 9 possibilities $(1+2+2+3)$ which is 3^2

$$(5, 6) \Rightarrow 3^2 = 9$$

$$\text{So, } (4, 5, 6) \Rightarrow 3^3 = 27$$

$$(3, 4, 5, 6) \Rightarrow 3^4 = 81$$

$$\text{Similarly, } (1, 2, 3, 4, 5, 6) \Rightarrow 3^6 = 729$$

Hence, the correct option is (A).

5.37 (A)

Given : A fair six-faced dice where the faces are labelled 1, 2, 3, 4, 5 and 6.

The probability of getting a "1" on the first roll of dice and the "4" on the second roll is,

$$\text{Probability of getting "1" on 1st roll} = \frac{1}{6}$$

$$\text{Probability of getting "4" on 2nd roll} = \frac{1}{6}$$

Since, both events are independent

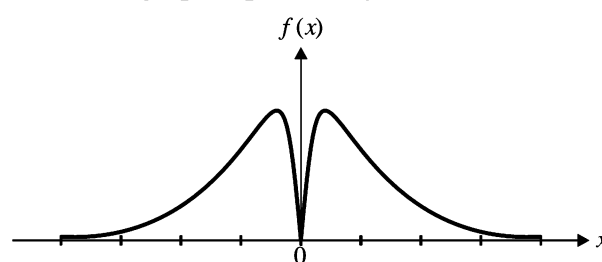
Probability of getting "1" on first roll and the "4" on the second roll

$$= \frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$$

Hence, the correct option is (A).

5.38 (A)

Given : A graph represents $f(x)$ versus x ,



The whole graph is above x-axis i.e. positive for all 'x'.

The given graph is also symmetrical about y-axis.

These two conditions satisfies in only even power of x, i.e. $f(x) = x^2 2^{-|x|}$

Hence, the correct option is (A).

5.39 (C)

Given : Mean can be greater, equal to or less than the median. So, statements (A) and statement (B) are not correct.

Mean is the average of the values given (in this case, scores of candidates) there for statement (D) is not correct.

Median is the middle value among the given set of values (scores of candidates) obtained by arranging the values in ascending or descending order and choosing the middle value.

Therefore, almost half the candidates have a score larger than the median (since it is the middle value).

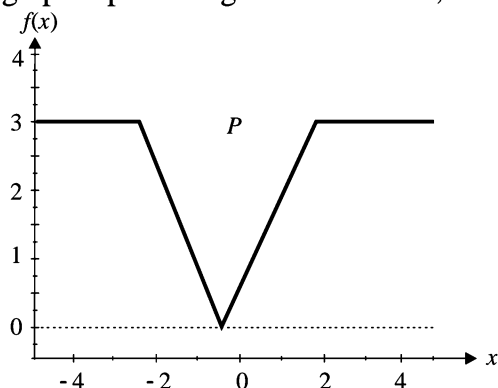
Hence, the correct option is (C).

5.40 (A)

Given : A graph represents $f(x)$ versus x,

Where, $f(x) = ||x+2| - |x-1||$

The graph represents given function is,

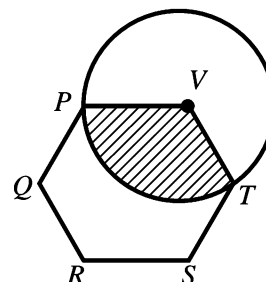


Hence, the correct option is (A).

5.41 (A)

Given : figure, PQRSTV is a regular hexagon with each side of length 5 cm. A circle is drawn with its centre at V such that it passes through P.

The area (in cm^2) of the shaded region in given figure can be find as,



Sum of interior angles = $(n-2)180^\circ$

Each angle of regular hexagon

$$\frac{(n-2)180^\circ}{n} = 120^\circ$$

$$\text{Required Area} = \frac{\theta}{360^\circ} \pi R^2 = \frac{120^\circ}{360^\circ} \pi 5^2 = \frac{25\pi}{3}$$

Hence, the correct option is (A).

5.42 (A)

Given : There are 4 red, 5 green, and 6 blue balls inside a box. Here, N number of balls are picked simultaneously, the smallest value of N that guarantees there will be at least two balls of the same colour can be fined as, where, one cannot see the colour of the balls until the are picked.

Let select three balls in wart case, balls are of different colours such that,

1 red ball, 4 green ball and 1 blue ball.

Now, if we pick fourth ball then the ball could be of red, green or blue coloured ball, than that 4th ball will be of same colour.

Hence, the minimum value of N could be 4.

Hence, the correct option is (A).

5.43 (A)

Given : The coefficient of x^4 in the polynomial $(x-1)^3(x-2)^3$ can be find as,

$$(a-b)^3 = a^3 - b^3 - 3a^2b + 2ab^2$$

$$(x-1)^3 = x^3 - 1^3 + 3x^2 + 3x \quad \dots(i)$$

$$(x-2)^3 = x^3 - 8^3 + 6x^2 + 12x \quad \dots(ii)$$

By multiplying equation (i) and (ii), we get

$$x^6 - 45x^3 + 33x^4 + 9x^5 + 6x^2 - 36x + 8 = 0$$

From the above equation,

Coefficient of x^4 is 33.

Hence, the correct option is (A).

5.44 (D)

Given : Two long dice are thrown together

Each dice having four rectangular faces labelled as 2, 3, 5 and 7

Probability of landing on rectangular faces is same $\left(\text{i.e., } \frac{1}{4}\right)$ and dice cannot land on square faces.

Total sample space of two long dice thrown and landing on rectangular face

$$n(s) = \begin{cases} (2,2) & (2,3) & (2,5) & (2,7) \\ (3,2) & (3,3) & (3,5) & (3,7) \\ (5,2) & (5,3) & (5,5) & (5,7) \\ (7,2) & (7,3) & (7,5) & (7,7) \end{cases}$$

Let A represent the event of occurrence of sum of two long dice scores greater than 11

$$n(A) = \{(5,7) (7,5) (7,7)\}$$

Required probability is given by

$$P(A) = \frac{n(A)}{n(s)} = \frac{3}{16}$$

$$P(A) = \frac{3}{16}$$

Hence, the correct option is (D).

5.45 (A)

Given : Sample of numbers

9, 18, 11, 14, 15, 17, 10, 69, 11, 13

Arranging the given sample in ascending order

9, 10, 11, 11, 13, 14, 15, 17, 18, 69

Number of observation = 10 = Even number

$$\text{Median} = \frac{\left[\left(\frac{n}{2}\right)^{\text{th}} \text{ term} + \left(\frac{n}{2} + 1\right)^{\text{th}} \text{ term}\right]}{2}$$

Here $n = 10$

$$\left(\frac{n}{2}\right)^{\text{th}} \text{ term} = 13$$

$$\left(\frac{n}{2} + 1\right)^{\text{th}} \text{ term} = 14$$

$$\text{Median} = \frac{13 + 14}{2}$$

$$\text{Median} = 13.5$$

Hence, the correct option is (A).

5.46 (A)

Given :

The probability of having two girls and one boy

$$= \text{GGB} + \text{GBG} + \text{BGG}$$

$$= \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$$

$$= \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{3}{8}$$

Hence the correct option is (A).

5.47 (A)

Given :

(i) P and Q play chess frequently against each other.

(ii) P wins 80% of matches.

$$P(W) = 0.8$$

(iii) Drawn 15% of the matches and lost 5% of the matches.

(iv) Probability of losing = $1 - 0.8$.

$$P(L) = 0.2$$

According to binomial distribution, the probability of r trials is given by,

$$P(r) = {}^nC_r \times (P)^r \times (q)^{n-r}$$

Here, $n = 3$, $r = 2$, $P = 0.8$, $q = 0.2$

$$P(X = r) = {}^nC_r (P)^r (q)^{n-r}$$

$$P(X = 2) = {}^3C_2 (0.8)^2 (0.2)^{3-2}$$

$$P(X = 2) = 3 \times 0.64 \times 0.2$$

$$P(X = 2) = 0.384 = \frac{48}{125}$$

Hence, the correct option is (A).

5.48 (B)

Let P_S and P_T be the probabilities of receiving offers from companies S and T respectively.

$$P_S = 0.8 \text{ and } P_T = 0.6$$

Note : Since, receiving an offer from one company does not affect the outcome of the other, means these are independent events.

Now, $P(A) = 0.8$ (Probability of getting an offer from S)

$P(B) = 0.6$ (Probability of getting an offer from T)

$$P(A \cap B) = 0.8 \times 0.6 = 0.48$$

Range $0.4 \leq P \leq 0.6$

Hence, the correct option is (B).

5.49 (A)

Given :

- A fair six - sided die has faces labeled 1, 2, 3, 4, 5 and 6.
- The die is rolled three times

Method 1

For each roll of the die :

The probability of rolling a 6 = $\frac{1}{6}$

The probability of not rolling a 6 = $\frac{5}{6}$
(rolling 1,2,3,4 or 5)

Since, we want exactly one 6 in three rolls the sequence can be

- (1) 6, (Not 6), (Not 6)
- (2) (Not 6), 6, (Not 6)
- (3) (Not 6), (Not 6), 6

Probability of rolling 6 once

$$= \left(\frac{1}{6}\right) \times \left(\frac{5}{6}\right) \times \left(\frac{5}{6}\right) = \frac{25}{216}$$

Since, the 6 can appear in any of the 3 positions

$$P(\text{exactly one 6}) = 3 \times \frac{25}{216} = \frac{75}{216}$$

Hence, the correct option is (A).

Method 2

Binomial distribution,

$$P(X = r) = n_c (p)^r (q)^{n-r}$$

$$n = 3 \text{ (number of rolls)}$$

$$r = 1$$

(We want exactly 1 success, meaning exactly one roll lands on 6)

$$p = \frac{1}{6} \text{ (Probability of rolling a 6)}$$

$$q = \frac{5}{6} \text{ (Probability of not rolling a 6)}$$

$$P(X = 1) = {}^3C_1 \left(\frac{1}{6}\right)^1 \left(\frac{5}{6}\right)^{3-1}$$

$$P(X = 1) = 3 \times \frac{1}{6} \times \left(\frac{5}{6}\right)^2 = \frac{75}{216}$$

The probability of rolling exactly one 6 is three rolls is $\frac{75}{216}$.

Hence, the correct option is (A).

5.50 (C)

Each match played results in exactly one player being eliminated.

The tournament begins with 64 players.

To determine a single overall winner, exactly 63 players must be eliminated.

Therefore, the total number of games played is equal to the number of eliminations.

$$\text{Total games} = n - 1 = 64 - 1 = 63.$$

Hence, the correct option is (C).

5.51 (D)

Based on the given parameters :

Minimum total credits = 60

Maximum total credits = 70

Core courses = Exactly 15 credits

Project = Exactly 20 credits

Specialization courses = Minimum 10 credits

First, calculate the absolute minimum mandatory credits required : 15 (core) + 20 (project) + 10 (specialization) = 45 credits.

To find the maximum possible elective credits, subtract these minimum mandatory credits from the maximum allowed total credits.

Maximum electives = $70 - 45 = 25$ credits

Hence, the correct option is (D).

5.52 (C)

Total possible outcomes when rolling a dice twice = $6 \times 6 = 36$

Now, count the favorable cases where the second number is a multiple of the first :

If first roll is 1 → Multiples : 1, 2, 3, 4, 5, 6 → (6 cases)

If first roll is 2 → Multiples : 1, 4, 6 → (3 cases)

If first roll is 3 → Multiples : 3, 6 → (2 cases)

If first roll is 4 → Multiples : 4 → (1 cases)

If first roll is 5 → Multiples : 5 → (1 cases)

If first roll is 6 → Multiples : 6 → (1 cases)

Total favorable outcomes
= $6 + 3 + 2 + 1 + 1 + 1 = 14$

Probability = $\frac{14}{36} = \frac{7}{18}$

Hence, the correct option is (C).

5.53 (C)

Step 1 : Identify the Given Data Based on the image :

- Students who like Mathematics
(M) : $n(M) = 10$

- Students who like English
(E) : $n(E) = 12$
- Students who like both
(M ∩ E) : $n(M \cap E) = 4$
- Students who like neither: 6

Step 2 : Calculate the Union (M ∪ E)

The union represents students who like at least one of the subjects.

Formula :

$$n(M \cup E) = n(M) + n(E) - n(M \cap E)$$

$$n(M \cup E) = 10 + 12 - 4$$

$$n(M \cup E) = 18$$

Step 3 : Calculate the Total Number of Students

The total group includes those who like at least one subject plus those who like neither.

Total student $n(M \cup E)$ + student who like neither.

Total students = $18 + 6 = 24$

Hence, the correct option is (C).

5.54 (A)

Probability of cloudy (C) = 0.5

Probability of sunny (S) = 0.5

Need probability of exactly 3 cloudy and 1 sunny in 4 days.

This is a binomial probability

$$P = {}^4C_3(0.5)^3(0.5)^1$$

$$= 4 \times (0.5)^4 = \frac{1}{4}$$

Hence, the correct option is (A).

5.55 (C)

Total outcomes when a die is rolled twice
= $6 \times 6 = 36$

Possible sums range from 2 to 12

Prime numbers between 2 and 12

2, 3, 5, 7, 11

Sum = 2

(1,1) → 1 outcome

Sum = 3

(1,2), (2,1) → 2 outcomes

Sum = 5

(1,4), (2,3), (3,2), (4,1) → 4 outcomes

Sum = 7

(1,6), (2,5), (3,4), (4,3), (5,2), (6,1) → 6 outcomes

Sum = 11

(5,6), (6,5) → 2 outcomes

Total favorable outcomes = 1 + 2 + 4 + 6 + 2 = 15

$$\text{Probability} = \frac{15}{36}$$

Hence, the correct option is (C).

Engineering Services Examination (ESE)

1. (D)

Given :

Number of white balls in 1st Bag = 4

Number of black balls in 1st Bag = 2

Number of white balls in 2nd Bag = 3

Number of black balls in 2nd Bag = 3

Since, probability of event,

$$P(E) = \frac{\text{Desirable Event}}{\text{Total Event}}$$

Therefore, probability of white balls in 1st bag

$$= \frac{4}{6}$$

$$P(E_1) = \frac{2}{3}$$

Similarly, probability of white balls in 2nd bag

$$= \frac{3}{6}$$

$$P(E_2) = \frac{1}{2}$$

Hence, P (getting white balls from both bags)

$$\begin{aligned} &= \frac{1}{2} [P(E_1) + P(E_2)] \\ &= \frac{1}{2} \left[\frac{2}{3} + \frac{1}{2} \right] = \frac{1}{2} \left(\frac{7}{6} \right) \\ &= \frac{7}{12} \end{aligned}$$

The probability of the white ball drawn is $\frac{7}{12}$.

Hence, the correct option is (D).

2. (D)

Method 1

Let 'S' be the sample space and 'E' be the event of choosing four persons such that 2 of them are children. Then,

⇒ $n(S)$ = number of ways of choosing 4 persons out of 9

As we know the number of ways of selecting r things out of n is equal to ${}^nC_r$,

$$\begin{aligned} \text{and } {}^nC_r &= \frac{n!}{r!(n-r)!} \\ &= {}^9C_4 = \frac{(9 \times 8 \times 7 \times 6)}{(4 \times 3 \times 2 \times 1)} = 126 \end{aligned}$$

$n(E)$ = Number of ways of choosing 2 children out of 4 and 2 persons out of (3+2) persons

$$= ({}^4C_2 \times {}^5C_2) = \left[\frac{(4 \times 3)}{(2 \times 1)} \right] \times \left[\frac{(5 \times 4)}{(2 \times 1)} \right] = 60$$

$$\therefore P(E) = n(E)/n(S) = 60/126 = 10/21$$

Hence, the correct option is (D).

Method 2

We need two children must out of 4 children

$$= {}^4C_2$$

We have to pick = 4 members

$$\therefore (3M + 2W) = 5 \text{ persons}$$

$$\frac{{}^5C_2 \times {}^4C_2}{{}^9C_4} = \text{we have to pick 4 members}$$

in which two of them are children

$$\frac{{}^5C_2 \times {}^4C_2}{{}^9C_4} = \frac{10}{21}$$

Hence, the correct option is (D).

3. (B)

The probability of selecting a capacitor with in the required tolerance value is $\frac{73}{100}$.

The probability that when randomly selecting a capacitor and then a second capacitor, if both are with in the required tolerance values when selecting with replacement is

$$= \frac{73}{100} \times \frac{73}{100} = 0.5329$$

Hence the correct option is (B).

4. (A)

Required of ways, $4^5 = 1024$

Hence, the correct option is (A).

5. (B)

$${}^{22}C_2 = \frac{22 \times 21}{2} = 231$$

Hence, the correct option is (B).

6. (B)

Let X = number of failures before the first success.

Then possible values of X are

$$X = 0, 1, 2, 3, \dots$$

Because :

- $X = 0$: success occurs in the first trial
- $X = 1$: first trial fails, second succeeds
- $X = 2$: first two fail, third succeeds
- And so on

If probability of success in each trial is p , then probability of failure is

$$q = 1 - p$$

Hence,

$$P(X = 0) = p$$

$$P(X = 1) = qp$$

$$P(X = 2) = q^2 p$$

$$P(X = r) = q^r p$$

Thus X follows geometric distribution.

The expectation is

$$E(X) = \sum_{r=0}^{\infty} r P(X = r)$$

$$E(X) = \sum_{r=0}^{\infty} r q^r p$$

$$E(X) = p \sum_{r=0}^{\infty} r q^r$$

Using the standard result

$$\sum_{r=0}^{\infty} r q^r = \frac{q}{(1-q)^2}$$

Therefore

$$E(X) = p \left(\frac{q}{(1-q)^2} \right)$$

But $1 - q = p$

$$\text{So, } E(X) = p \left(\frac{q}{p^2} \right)$$

$$E(X) = \frac{q}{p}$$

Thus

$$E(X) = \frac{q}{p}$$

Hence, the correct option is (B).

7. (A)

Let x be the total number of matches

For each card i , define

$$x_i = \begin{cases} 1, & \text{If card } i \text{ is placed in cell } i \\ 0, & \text{Otherwise} \end{cases}$$

Then, $x = x_1 + x_2 + \dots + x_n$

Expectation : probability that a card matches its cell $= \frac{1}{n}$.

$$E(x_i) = \frac{1}{n}$$

$$E(x) = n \times \frac{1}{n} = 1$$

Variance :

$$\text{Var}(x_i) = \frac{1}{n} \left(1 - \frac{1}{n} \right) = \frac{n-1}{n^2}$$

For

$$i \neq j$$

$$\text{cov}(x_i, x_j) = \frac{1}{n(n-1)} - \frac{1}{n^2}$$

$$\text{Now, } \text{Var}(x) = \sum \text{Var}(x_i) + 2 \sum \text{cov}(x_i, x_j)$$

$$\text{Var}(x) = \frac{n(n-1)}{n^2} + \frac{2n(n-1)}{2} \left(\frac{1}{n(n-1)} - \frac{1}{n^2} \right)$$

$$\text{Var}(x) = \frac{n-1}{n} + \frac{1}{n} = 1$$

Hence, the correct option is (A).

8. (B)

$$\text{Var}(x_1) = k$$

$$\text{Var}(x_2) = 4$$

$$\text{Var}(y) = 3x_2 - x_1 \text{ is } 49$$

$$\text{Var}(x) = \text{var}[(3x_2) - x_1]$$

$$= (3^2) \text{var}(x_2) + (-1)^2 \text{Var}(x_1)$$

$$49 = 9 \times 4 + 1 \times k$$

$$49 = 36 + k$$

$$k = 13$$

Hence, the correct option is (B).

9. (B)

Given join PDF :

$$f(x, y) = 3(x + y), \quad 0 \leq x \leq 1, \quad 0 \leq y \leq 1, \\ x + y \leq 1$$

We need

$$P\left(X + Y < \frac{1}{2}\right)$$

So,

$$P\left(X + Y < \frac{1}{2}\right) = \int_0^{1/2} \int_0^{1/2-x} 3(x + y) dy dx$$

$$= \int_0^{1/2} 3 \left[xy + \frac{y^2}{2} \right]_0^{1/2-x} dx$$

$$= \int_0^{1/2} 3 \left[x \left(\frac{1}{2} - x \right) + \frac{\left(\frac{1}{2} - x \right)^2}{2} \right] dx$$

After simplification,

$$= \int_0^{1/2} \left(\frac{3x}{2} - 3x^2 + \frac{3}{2} \left(\frac{1}{4} - x + x^2 \right) \right) dx$$

$$= \int_0^{1/2} \left(\frac{3}{8} - \frac{3x^2}{2} \right) dx$$

$$= \left[\frac{3x}{8} - \frac{x^3}{2} \right]_0^{1/2}$$

$$= \frac{3}{16} - \frac{1}{16} = \frac{1}{8}$$

Hence,

$$\frac{1}{8}$$

Hence, the correct option is (B).

10. (B)

For fair coin,

$$p = 0.5$$

$$q = 0.5$$

Desired relative frequency :

$$0.49 \leq \hat{p} \leq 0.51$$

So allowable error is

$$e = 0.01$$

Using confidence interval formula:

$$n = \frac{z^2 pq}{e^2}$$

Given $z = 1.645$

$$n = \frac{(1.645)^2 (0.5)(0.5)}{(0.01)^2}$$

$$= \frac{2.706 \times 0.25}{0.0001}$$

$$= \frac{0.6765}{0.0001}$$

$$= 6765$$

Hence, the correct option is (B).



6

Time, Speed & Distance

INTRODUCTION :

The fundamental relationship between distance (D), time (T) and speed (S) is given by,

$$D = S \times T$$

Let v_1 and v_2 be the velocity of the two vehicles and let $v_1 > v_2$. If both the vehicles are moving in the same direction then their relative velocity = $v_1 - v_2$. If both the vehicles are moving in the opposite direction then their relative velocity = $v_1 + v_2$.

IMPORTANT POINTS :

1. Average speed :

$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$

- (i) If d_1 and d_2 are the distances covered at speeds v_1 and v_2 respectively and the time taken are t_1 and t_2 respectively, then the average speed over the entire distance ($d_1 + d_2$) is given by

$$\frac{\text{Total distance covered}}{\text{Total time taken}} = \frac{d_1 + d_2}{t_1 + t_2} = \frac{d_1 + d_2}{\frac{d_1}{v_1} + \frac{d_2}{v_2}}$$

- (ii) If both the distance are equal i.e. $d_1 = d_2 = d$ then,

$$\text{Average speed} = \frac{2v_1v_2}{v_1 + v_2}$$

- (iii) If both the time taken are equal i.e. $t_1 = t_2 = t$ then,

$$\text{Average speed} = \frac{v_1 + v_2}{2}$$

2. If the distance is covered in three equal parts with different speeds v_1 , v_2 and v_3 then, average velocity = $\frac{3v_1v_2v_3}{v_1v_2 + v_2v_3 + v_3v_1}$.

3. For the same distance, the time is inversely proportional to the speed of the object. These types of problems can be solved as the problems of percentage.
- (i) If the speed of the bodies is changed in the ratio $x : y$, then ratio of the time is in the ratio $y : x$.
- (ii) When time is constant then ratio of speeds of the object is equal to the ratio of the distance covered by them i.e. $\frac{v_1}{v_2} = \frac{d_1}{d_2}$

TRAINS :

1. When a train approaches a stationary object (a tree, a stationary man, a lamp post, we assume the length of the object to be infinitely small, provided its length isn't mentioned)

$$\text{Time taken by the train to cross the object} = \frac{\text{Length of the train}}{\text{Speed of the train}}$$

However, when a train approaches a platform, the time taken by the train to cross the platform is same as the time taken by the train to cross a distance equal to its own length plus the length of the platform as its own velocity.

$$\text{Time taken to cross the platform} = \frac{\text{Length of train} + \text{Length of platform}}{\text{Speed of train}}$$

2. For two trains having lengths l_1 and l_2 , traveling in the same direction with speeds v_1 and v_2 respectively ($v_1 > v_2$).

$$\text{Time taken to cross each other completely} = \frac{\text{Total distance}}{\text{Relative speed}} = \frac{l_1 + l_2}{v_1 - v_2}$$

Similarly, for two trains traveling in the opposite direction,

$$\text{Time taken to cross each other completely} = \frac{\text{Total distance}}{\text{Relative velocity}} = \frac{l_1 + l_2}{v_1 + v_2}$$

3. If two trains or objects start at the same time from two points X and Y and move towards each other and after crossing they take A and B hrs respectively to reach opposite points Y and X , then

$$\frac{X's \text{ speed}}{Y's \text{ speed}} = \sqrt{\frac{B}{A}}$$

BOATS AND STREAMS :

Let speed of boat in still water = B km/hr

Speed of stream = S km/hr

Speed of boat with the stream (Down Stream),

$$x = B + S$$

Speed of boat against stream (Up stream),

$$y = B - S$$

Speed of boat in still water,

$$B = \frac{1}{2}(x + y)$$

Speed of stream,

$$S = \frac{1}{2}(x - y)$$

IMPORTANT POINTS :

1. Speed of man/boat in still water $X = \frac{(X + Y) + (X - Y)}{2} = \frac{\text{Upstream} + \text{Downstream}}{2}$
2. Speed of the stream $Y = \frac{(X + Y) - (X - Y)}{2} = \frac{\text{Downstream} - \text{Upstream}}{2}$
3. If a man capable of rowing at the speed of X m/sec in still water, rows the same distance up and down a stream flowing at a rate of Y m/sec, then his average speed throughout the journey is

$$\frac{\text{Upstream} \times \text{Downstream}}{\text{Man's rate in still water}} = \frac{(X - Y)(X + Y)}{X}$$
4. When downstream distance = upstream distance, then

$$\text{Total journey time } (t_{up} + t_{down}) = \frac{\text{Man's rate in still water} \times \text{Total distance}}{\text{Upstream rate} \times \text{Downstream rate}}$$

Example 1

A train running at a 54 kmph takes 20 seconds to pass a platform. Next it takes 12 seconds to pass a man walking at 6 kmph in the same direction in which the train is going. Find the length of the train and the length of the platform?

Solution :

Given :

(i) Speed of train 54 kmph $= 54 \times \frac{5}{18} = 15$ m/s

(ii) Time taken to passing platform = 20 sec

Let the length of the train be x m and the length of the platform be y m.

Speed of the train relative to man $= 54 - 6 = 48$ kmph or $40/3$ m/s

In passing a man, train covers its own length with relative speed

So, length of the train = Relative speed $\times$ time $= \frac{40}{3} \times 12 = 160$ m

Therefore, $x + y = \frac{54 \times 20 \times 1000}{300}$

$y = 140$ m

Hence, the length of the train is 160 m and the length of the platform is 140 m.

Example 2

The speed of a train in the onward journey is 25% more than that in the return journey. The train halts for 1 hour on reaching the destinations. The total time taken by the train to complete the whole journey is 17 hours, covering a distance of 800 km. The speed of the train in the onward journey is?

Solution :

Let the speed in return journey be x kmph

Then speed in onward journey = $\frac{125x}{100} = \frac{5x}{4}$ kmph

Average speed = $\frac{10x}{9}$ kmph

Therefore, $800 \times \frac{9}{10x} = 17 - 1$

So, $x = 45$ kmph

So, speed in onward journey = $\frac{5}{4} \times 45 = 56.25$ kmph

Hence, the speed of the train in the onward journey is 56.25 kmph.



2013 IIT Bombay

- 6.1** A car travels 8 km in the first quarter of an hour, 6 km in the second quarter and 16 km in the third quarter. The average speed of the car in km per hour over the entire journey is [EC, EE, IN]
 (A) 30 (B) 36
 (C) 40 (D) 24
- 6.2** Velocity of an object fired directly in upward direction is given by $V = 80 - 32t$, where t (time) is in seconds. When will the velocity be between 32 m/sec and 64 m/sec?
 [AE, AG, BT, CH, CY, MN, XE, XL]
 (A) 1, $3/2$ (B) $1/2$, 1
 (C) $1/2$, $3/2$ (D) 1, 3
- 6.3** A tourist covers half of his journey by train at 60 km/h, half of the remainder by bus at 30 km/h and the rest by cycle at 10 km/h. The average speed of the tourist in km/h during his entire journey is [CS, ME, PI]
 (A) 36 (B) 30
 (C) 24 (D) 18

2014 IIT Kharagpur

- 6.4** A train that is 280 meters long, travelling at a uniform speed, crosses a platform in 60 seconds and passes a man standing on the platform in 20 seconds. What is the length of the platform in meters?
 [EC-1, ME-1]
- 6.5** A man can row at 8 km per hour in still water. If it takes him thrice as long to row upstream, as to row downstream, then find the stream velocity in km per hour.
 [EC-3, ME-3]

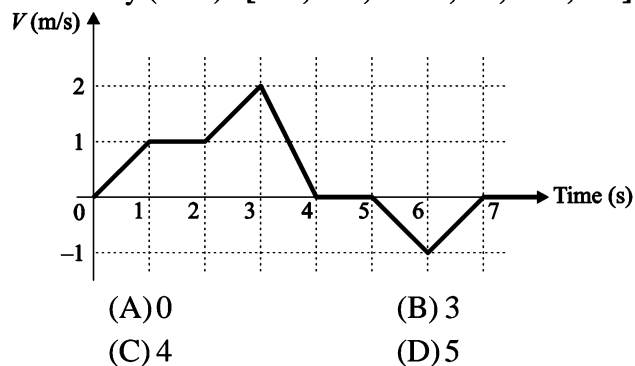
2015 IIT Kanpur

- 6.6** A tiger is 50 leaps of its own behind a deer. The tiger takes 5 leaps per minute

to the deer is 4. If the tiger and the deer cover 8 metre and 5 metre per leap respectively, what distance in metres will the tiger have to run before it catches the deer?
 [EC-2, ME-1]

2016 IISc Bangalore

- 6.7** Michael lives 10 km away from where I live. Ahmed lives 5 km away and Susan lives 7 km away from where I live. Arun is farther away than Ahmed but closer than Susan from where I live. From the information provided here, what is one possible distance (in km) at which I live from Arun's place? [EC-1, ME-1]
 (A) 3.00 (B) 4.99
 (C) 6.02 (D) 7.01
- 6.8** It takes 10 s and 15 s, respectively, for two trains travelling at different constant speeds to completely pass a telegraph post. The length of the first train is 120 m and that of the second train is 150 m. The magnitude of the difference in the speeds of the two trains (in m/s) is _____.
 [AR, CY, EC-3, IN, MA, PE]
 (A) 2.0 (B) 10.0
 (C) 12.0 (D) 22.0
- 6.9** The velocity V of a vehicle along a straight line is measured in m/s and plotted as shown with respect to time in seconds. At the end of the 7 seconds, how much will the odometer reading increase by (in m)? [AR, CY, EC-3, IN, MA, PE]



2017 IIT Roorkee

- 6.10** Trucks (10 m long) and cars (5 m long) go on a single lane bridge. There must be a gap of at least 20 m after each truck and a gap of at least 15 m after each car. Trucks and cars travel at a speed of 36 km/h. If cars and trucks go alternately, what is the maximum number of vehicles that can use the bridge in one hour?

[BT, CY, EC-1, EY, PI]

- (A) 1440 (B) 1200
(C) 720 (D) 600
- 6.11** Budhan covers a distance of 19 km in 2 hours by cycling one fourth of the time and walking the rest. The next day he cycles (at the same speed as before) for half the time and walks the rest (at the same speed as before) and covers 26 km in 2 hours. The speed in km/h at which Budhan walks is [CE-2, IN, XE, XL]
- (A) 1 (B) 4
(C) 5 (D) 6
- 6.12** An automobile travels from city A to city B and returns to city A by the same route. The speed of the vehicle during the onward and return journeys were constant at 60 km/h and 90 km/h respectively. What is the average speed in km/h for the entire journey?

[CE-1, CH, MN]

- (A) 72 (B) 73
(C) 74 (D) 75

2018 IIT Guwahati

- 6.13** A 1.5 m tall person is standing at a distance of 3 m from a lamp post. The light from the lamp at the top of the post casts her shadow. The length of the shadow is twice her height. What is the height of the lamp post in meters? [EC]

- (A) 1.5 (B) 3
(C) 4.5 (D) 6

- 6.14** Tower A is 90 m tall and tower B is 140 m tall. They are 100 m apart. A horizontal skywalk connects the floors at 70 m in both the towers. If a taut rope connects the top of tower A to the bottom of tower B, at what distance (in meters) from tower A will the rope intersect the skywalk? [CE-1]

- 6.15** From the time the front of a train enters a platform, it takes 25 sec for the back of the train to leave the platform, while train travelling at a constant speed of 54 km/h. At the same speed, it takes 14 sec to pass a man running at 9 km/h in the same direction as the train. What is the length of the train and that of the platform in meters respectively?

[EY, ME-1, PE, XE, XL]

- (A) 210 and 140 (B) 162.5 and 187.5
(C) 245 and 130 (D) 175 and 200

2019 IIT Madras

- 6.16** Two cars start at the same time from the same location and go in the same direction. The speed of the first car is 50 km/h and the speed of the second car is 60 km/h. The number of hours it takes for the distance between the two cars to be 20 km is _____. [CH, CS]

- (A) 1 (B) 2
(C) 3 (D) 6

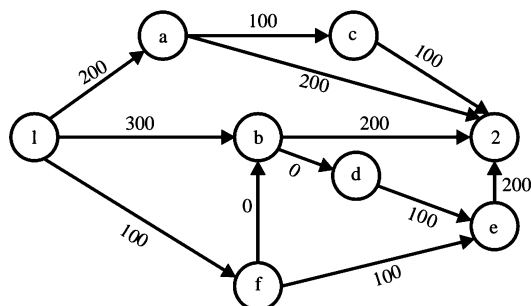
- 6.17** Two trains started at 7AM from the same point. The first train travelled north at a speed of 80km/h and the second train travelled south at a speed of 100 km/h. The time at which they were 540 km apart is _____ AM.

[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]

- (A) 9 (B) 10
(C) 11 (D) 11.30

2020 IIT Delhi

- 6.18** There are multiple routes to reach from node 1 to node 2, as shown in the network.



The cost of travel on an edge between two nodes is given in rupees. Node 'a', 'b', 'c', 'd', 'e' and 'f' are toll booths. The toll price at toll booths marked 'a' and 'e' is Rs. 200, and is Rs. 100 for the other toll booths. Which is the cheapest route from node 1 to node 2? [CS]

- (A) 1-f-e-2 (B) 1-b-2
(C) 1-a-c-2 (D) 1-f-b-2
- 6.19** The distance between Delhi and Agra is 233 km. A car P started travelling from Delhi to Agra and another car Q started from Agra to Delhi along the same road 1 hour after the car P started. The two cars crossed each other 75 minutes after the car Q started. Both cars were travelling at constant speed. The speed of car P was 10 km/hr more than the speed of car Q. How many kilometers the car Q had travelled when the cars crossed each other?

[AR, BM, BT, CH, MA, MN, ST, XE, XL]

- (A) 116.5 (B) 88.2
(C) 66.6 (D) 75.2

2022 IIT Kharagpur

- 6.20** In a 500 m race, P and Q have speeds in the ratio of 3 : 4. Q starts the race when P has already covered 140 m. What is the distance between P and Q (in m) when P wins the race?

[EE]

- (A) 20 (B) 140
(C) 40 (D) 60

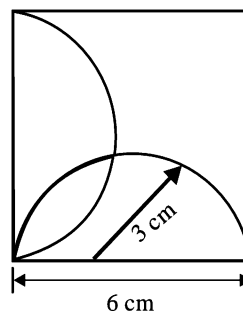
- 6.21** Three bells P , Q and R are rung periodically in a school. P is rung every 20 minutes, Q is rung every 30 minutes and R is rung every 50 minutes. If all the three bells are rung at 12:00 PM, when will the three bells ring together again the next time?

[EE]

- (A) 6:30 PM (B) 5:00 PM
(C) 6:00 PM (D) 5:30 PM

2023 IIT Kanpur

- 6.22** A square with sides of length 6 cm is given. The boundary of the shaded region is defined by two semi-circles whose diameters are the sides of the square, as shown.



The area of the shaded region is _____ cm^2 . [EE]

- (A) 6π (B) 18
(C) 20 (D) 9π

2025 IIT Roorkee

- 6.23** Two cars, P and Q, start from a point X in India at 10 AM. Car P travels North with a speed of 25 km/h and car Q travels East with a speed of 30 km/h. Car P travels continuously but car Q stops for some time after travelling for one hour. If both the cars are at the same distance from X at 11:30 AM, for how long (in minutes) did car Q stop? **[ME, PE]**
- (A) 10 (B) 12
(C) 15 (D) 18

Engineering Services Examination (ESE)

- 1.** A person travelled by car 70 km towards north to A then covered 30 km turning left to B. Again he turned towards left and travelled 110 km to C. Then he cycled at the rate of 10 km/hour towards the starting point. The time taken by him to reach the starting point from C will be:
- (A) 3 hours (B) 5 hours

(C) 7 hours

(D) 21 hours

[ESE 2019]

- 2.** A tourist covers half of his journey by train at 60 km/h, half of the remaining by bus at 30 km/h and the rest by cycle at 10 km/h. Average speed of the tourist during the journey is :

(A) 36 km/h

(B) 33 km/h

(C) 24 km/h

(D) 18 km/h

[ESE 2019]

- 3.** Two trains 120 m and 80 m length are running in opposite direction with velocities 42 km/hour and 30 km/hour respectively. To cross each other completely, the time taken will be

(A) 10 sec

(B) 15 sec

(C) 18 sec

(D) 20 sec

[ESE 2025]

Answers

Time, Speed & Distance

6.1	C	6.2	C	6.3	C	6.4	560	6.5	4
6.6	800	6.7	C	6.8	A	6.9	D	6.10	A
6.11	D	6.12	A	6.13	B	6.14	22.22	6.15	D
6.16	B	6.17	B	6.18	D	6.19	D	6.20	A
6.21	B	6.22	B	6.23	C				
Engineering Services Examination (ESE)									
1.	B	2.	C	3.	A				

Explanations

Time, Speed & Distance

6.1 (C)

Given : A car travels :

8 km in 15 minutes

6 km in next 15 minutes

16 km in next 15 minutes

Average speed is given by,

$$v = \frac{\text{Total distance}}{\text{Total time taken}}$$

$$v = \frac{8+6+16}{15+15+15} \text{ (km/min)}$$

$$v = \frac{30}{45} \text{ (km/min)}$$

$$v = \frac{30}{45} \times 60 = 40 \text{ (km/hr)}$$

Hence, the correct option is (C).

6.2 (C)

Given : Velocity $V = 80 - 32t$

At $V = 32$ m/sec,

$$32 = 80 - 32t$$

$$t = \frac{3}{2}$$

At $V = 64$ m/sec,

$$64 = 80 - 32t$$

$$t = \frac{1}{2}$$

Hence, the correct option is (C).

6.3 (C)

Let ' l ' be the total distance.

Average speed,

$$S_{\text{avg}} = \frac{\text{Total distance covered}}{\text{Total time}}$$

$$S_{\text{avg}} = \frac{l}{\frac{l}{2} + \frac{l}{4} + \frac{l}{4}} = \frac{1}{\frac{1}{120} + \frac{1}{120} + \frac{1}{40}}$$

$$S_{\text{avg}} = \frac{120}{5}$$

$$S_{\text{avg}} = 24 \text{ km/h}$$

Hence, the correct option is (C).

6.4 560

Given : Length of train = 280(m)

Consider length of platform = L (m)

Method 1

While passing a platform, a train covers the length of its own and the length of platform.

$$\text{Distance} = (280 + L)\text{m}$$

And it takes 60 sec. to cross it with speed of S_T m/sec.

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$(280 + L) = S_T \times 60 \quad \dots(i)$$

While passing a man, a train covers only the length of its own.

$$\text{Distance} = 280\text{m}$$

With a speed of S_T m/sec, it takes 20 sec.

$$280 = S_T \times 20 \quad \dots(ii)$$

Solving equation (i) and (ii),

$$\frac{280 + L}{280} = \frac{60}{20}$$

$$L = (280 \times 3) - 280 = 560 \text{ m}$$

Hence, length of platform is **560 m**.

Method 2

Let the speed of train = v

Length of platform = l

Length of train = $L = 280 \text{ m}$

To cross a man standing on the platform, the train has to travel a distance equal to its length.

So, according to question,

$$\frac{L}{v} = 20 \text{ sec}$$

$$\frac{280}{v} = 20$$

$$v = 14 \text{ m/s}$$

To cross the platform it has to travel a distance equal to the sum of the length of train & length of platform,

$$\frac{L + l}{v} = 60$$

$$\frac{280 + l}{14} = 60$$

$$l = 560 \text{ m}$$

Hence, length of platform is **560 m**.

6.5 4

Given :

Speed of man, $x = 8 \text{ kmph}$

And speed of stream = $y \text{ kmph}$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

Time in upstream = $3 \times$ Time in downstream

$$\frac{D}{x - y} = \frac{3 \times D}{x + y}$$

$$(x + y) = 3(x - y)$$

$$x + y = 3x - 3y$$

$$2x = 4y$$

$$y = \frac{x}{2} \quad \{\text{since, } x = 8\}$$

$$y = 4 \text{ kmph}$$

Hence, the stream velocity is **4 kmph**.

6.6 800

Given : Tiger is 50 leap of its own behind deer.

The distance covered per leap by tiger, $l_t = 8 \text{ m}$

The distance covered per leap by deer, $l_p = 5 \text{ m}$

So, initial separation = $50 \times 8 = 400 \text{ m}$

Speed = Number of leaps $\times$ distance per leap

Speed of tiger and deer are :

$$v_T = 5 \times 8 = 40 \text{ m/minute}$$

$$v_D = 4 \times 5 = 20 \text{ m/minute}$$

Now relative distance of 400 m have to be covered with $(40 - 20) = 20 \text{ m/min}$

$$\text{Required time} = \frac{\text{Distance}}{\text{Relative speed}}$$

$$= \frac{400 \text{ m}}{(40 - 20) \text{ m/min}} = 20 \text{ min}$$

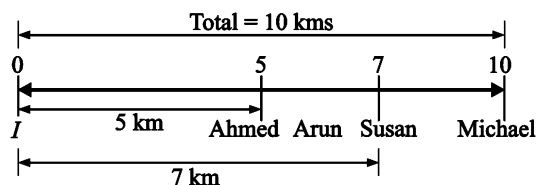
So, the distance travelled by tiger is

$$= 40 \text{ m/min} \times 20 \text{ min} = 800 \text{ m}$$

Hence, the distance is **800 m**.

6.7 (C)

Following line with respective distances can be drawn



Arun can reside anywhere between Ahmed and Susan i.e. between 5 km and 7 km from I.

From options, only 6.02 is between the range

$$5 < 6.02 < 7$$

Hence, the correct option is (C).

6.8 (A)

Given :

Length of first train = 120 m

Length of second train = 150 m

Speed of the train (S)

$$= \frac{\text{Length of the train } (L) + \text{Distance } (D)}{\text{Time } (T)}$$

Hence,

Speed of first train,

$$S_1 = \frac{120}{10} = 12 \text{ m/s}$$

Speed of second train,

$$S_2 = \frac{150}{15} = 10 \text{ m/s}$$

Therefore, the magnitude of the difference in the speeds of the two trains (m/s) = $12 - 10 = 2 \text{ m/s}$

Hence, the correct option is (A).

6.9 (D)

The odometer reading increases from starting point to end point.

Magnitude of area of the given diagram

= Odometer reading

Magnitude of area of the velocity and time graph per second

(0–1) 1st sec :

$$\text{Triangle} = \frac{1}{2} \times 1 \times 1 = \frac{1}{2} \text{ m}$$

(1–2) 2nd sec :

$$\text{Square} = 1 \times 1 = 1 \text{ m}$$

(2–3) 3rd sec :

$$\text{Square} + \text{triangle} = 1 \times 1 + \frac{1}{2} \times 1 \times 1 = \frac{3}{2} \text{ m}$$

(3–4) 4th sec :

$$\text{Triangle} = \frac{1}{2} \times 1 \times 2 = 1 \text{ m}$$

(4–5) 5th sec :

$$\text{Straight line} = 0$$

(5–6) 6th sec :

$$\text{Triangle} = \frac{1}{2} \times 1 \times 1 = \frac{1}{2} \text{ m}$$

(6–7) 7th sec :

$$\text{Triangle} = \frac{1}{2} \times 1 \times 1 = \frac{1}{2} \text{ m}$$

Total Odometer reading at 7 seconds (0–7)

$$= \frac{1}{2} + 1 + \frac{3}{2} + 1 + 0 + \frac{1}{2} + \frac{1}{2} = 5 \text{ m}$$

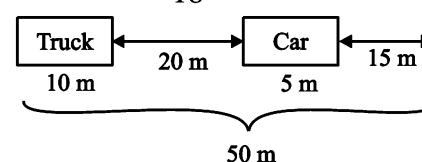
Hence, the correct option is (D).

6.10 (A)

Given :

	Length	Gap
Truck →	10 m	20 m
Car →	5 m	15 m

$$\text{Speed} = 36 \text{ km/hr} \times \frac{5}{18} = 10 \text{ m/s}$$



$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{50}{10} = 5 \text{ sec}$$

If 50 m distance is covered in 5 seconds by two vehicles (one truck and one car). Then in one hour maximum number of vehicles passing through the lane

$$= \frac{3600 \times 2}{5} = 1440$$

Hence, the correct option is (A).

6.11 (D)

Given : Budhan covers a total distance of 19 km in 120 minutes by cycling for 30 minutes and walking for 90 minutes.

So, $30C + 90W = 19 \text{ km}$... (i)

The next day, Budhan covers 26 km in 120 minutes by cycling for 60 minutes and walking for 60 minutes.

So, $60C + 60W = 26 \text{ km}$... (ii)

Both days the speed of cycling and walking is the same.

From equations (i) and (ii),

$$C = 0.33 \text{ km/min}$$

$$W = 0.1 \text{ km/min}$$

$$W = 0.1 \times 60 = 6 \text{ km/h}$$

Hence, the correct option is (D).

6.12 (A)

Given : Speed of vehicle during onward journey = 60 km/hr

Speed of vehicle during return = 90 km/hr

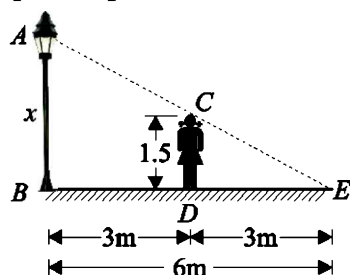
Let total distance = x km

$$\text{Average speed} = \frac{x+x}{\frac{x}{60} + \frac{x}{90}} = 72 \text{ km/hr}$$

Hence, the correct option is (A).

6.13 (B)

Given : Height of person (CD) = 1.5 m, Distance from lamp post to person (BD) = 3 m.



From similar triangle rule,

$$\frac{AB}{CD} = \frac{BE}{DE}$$

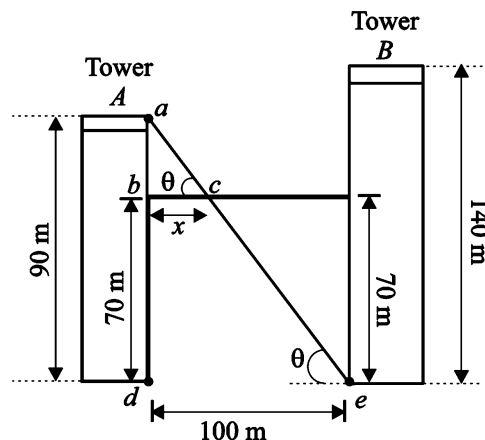
$$\frac{x}{1.5} = \frac{6}{3}$$

$$x = \frac{6 \times 1.5}{3} = 3 \text{ m}$$

Hence, the correct option is (B).

6.14 22.22

According to given data figure is shown below,



In above figure,

$$\tan \theta = \frac{AD}{DE} = \frac{AB}{BC}$$

$$\frac{90}{100} = \frac{20}{x}$$

$$x = \frac{2000}{90} = 22.22 \text{ m}$$

Hence, the distance between tower A and rope-skywalk intersect is **22.22 m**.

6.15 (D)

Given : Speed of train = 54 km/h

Time for travelling the length of train and length of platform = 25 sec

Speed of man = 9 km/h

Speed of train = $54 - 9 = 45 \text{ km/h}$

Time taken by the train to pass the man = 14 sec

Length of train = Speed $\times$ Time

$$= 45 \times \frac{5}{18} \times 14 = 175 \text{ m}$$

Total length = Speed of train $\times$ Time

$$= 54 \times \frac{5}{18} \times 25 = 375 \text{ m}$$

Length of platform = $375 - 175 = 200 \text{ m}$

Hence, the correct option is (D).

6.16 (B)**Given :**

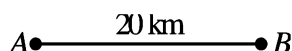
- (i) Speed of first car is 50 km/h.
- (ii) Speed of second car is 60 km/h.

Let us assume first car A is stationary than speed of second car B will be $(60 - 50)$ km/h

$$= 10 \text{ km/h}$$

So, the number hours required for the distance between A and B to be 20 km

$$= \frac{20 \text{ km}}{10 \text{ km/h}} = 2 \text{ hours}$$

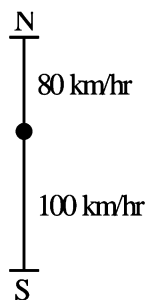


So, the distance between the two cars will be 20 km in two hours.

Hence, the correct option is (B).

6.17 (B)**Given :**

- (i) Train started at 7 AM from the same point.
- (ii) Speed of first train in north direction = 80 km/h
- (iii) Speed of second train in south direction = 100 km/h



The distance between them after one hour is 180 km.

So, the distance will be 540 km in,

$$\frac{540}{180} = 3 \text{ hrs.}$$

Three hours later i.e. at 10 AM the distance will be 540 km.

Hence, the correct option is (B).

6.18 (D)

Checking from the options

Option (A) :

$$1 - f - c - 2 = 100 + 100 \\ + 100 + 200 + 200 = \text{Rs } 700$$

Option (B) :

$$1 - b - 2 = 300 + 100 + 200 = \text{Rs } 600$$

Option (C) :

$$1 - a - c - 2 = 200 + 200 \\ + 100 + 100 + 100 = \text{Rs } 700$$

Option (D) :

$$1 - f - b - 2 = 100 + 100 \\ + 0 + 100 + 200 = \text{Rs } 500$$

Clearly, route $1 - f - b - 2$ is the cheapest route from node 1 to node 2.

Hence, the correct option is (D).

6.19 (D)

Given : The distance between Delhi and Agra is 233 km.

Delhi $\xrightarrow{233\text{km}}$ Agra

Car P $\rightarrow$ $\leftarrow$ Car Q

Car P and Q crossed each other 75 minutes after the car Q started.

Let x km be the distance covered by Car Q in 75 minutes.

$$\therefore \text{Speed at Car Q} = \frac{x}{\frac{75}{60}} \text{ km/hr} = \frac{4x}{5} \text{ km/hr}$$

$$\therefore \text{Speed at Car P} = \frac{4x}{5} + 10 \text{ km/hr}$$

This distance has been covered by car P = 1 hr

$$\text{and } 75 \text{ min} = \frac{9}{4} \text{ hr}$$

$$\therefore \text{The distance covered by car P till the point of crossing} = (233 - x)$$

The distance travelled by car Q is given by,

$$(233 - x) = \frac{9}{4} \left(\frac{4x}{5} + 10 \right)$$

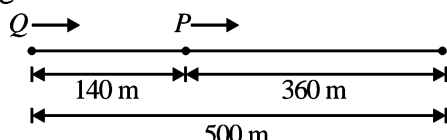
$$x = 75.2 \text{ km}$$

Hence, the correct option is (D).

6.20 (A)

Given : P and Q have speed $3x$ and $4x$ respectively.

P has already covered 140 m at the time of starting of the race.



Distance = Speed $\times$ Time

Distance covered by P is $3x \times t = 360 \text{ m}$

$$xt = 120 \text{ m}$$

Distance covered by Q is

$$4x \times t = 4 \times 120 = 480 \text{ m}$$

So, the distance between P and Q, when P wins the race = $500 \text{ m} - 480 \text{ m} = 20 \text{ m}$

Hence, the correct option is (A).

6.21 (B)

Given : Three bells P, Q and R rings periodically in a school.

P rings in every 20 minutes, Q rings in every 30 minutes and R rings in every 50 minutes.

Bells P, Q and R will ring after the respective Least Common Multiple of ringing time intervals of them.

Least Common Multiple of 20 min, 30 min and 50 min is 300 min.

Where 300 minutes is equals to 5 hours.

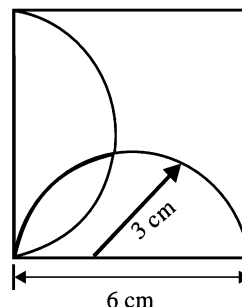
As, all the three bells rangs at 12:00 PM then after 5 hours at 5 PM.

Hence, the correct option is (B).

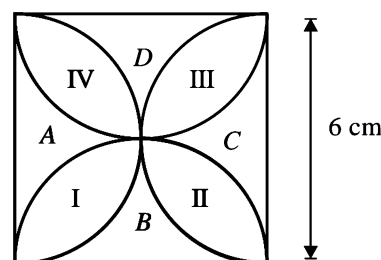
6.22 (B)

Given : A square with sides of length 6 cm.

The boundary of the shaded region is defined by two semicircles whose diameters are the sides of the square as shown in below figure.



The area of the shaded region in cm^2 can be find as,



$$\begin{aligned} \text{Area of region } (A + B + C + D) &= 2[36 - (\pi \cdot 3^2)] \\ &= 72 - 18\pi \end{aligned}$$

$$\begin{aligned} \text{Area of region } (I + II + III + IV) &= 36 - [72 - 18\pi] = 18\pi - 36 \end{aligned}$$

$$\text{Area of region "P"} = (18\pi - 36)/4 = \frac{9\pi}{2} - 9$$

$$\text{Area of shared region} = \text{Area of } (A + B + I)$$

$$\begin{aligned} &= \frac{\pi 3^3}{2} - I + \frac{\pi 3^2}{2} - I \\ &= \frac{9\pi}{2} + \frac{9\pi}{2} - 2 \left(\frac{9\pi}{2} - 9 \right) \\ &= 9\pi - (9\pi - 18) = 18 \end{aligned}$$

Hence, the correct option is (B).

6.23 (C)

Given :

- Two Cars P and Q start from point X at 10:00 AM.
- Car P moves north at 25 km/h continuously.

- (iii) Car Q moves east at 30 km/h but stops after 1 hour for some time.
 (iv) At 11:30 AM both cars at the same distance from X.

Distance travelled by Car P :

$$D_p = \text{Speed} \times \text{Time}$$

$$D_p = (25 \text{ km/h}) \times (1.5 \text{ h})$$

$$D_p = 37.5 \text{ km}$$

Total time from 10:00 AM to 11:30 AM = 1.5 hours.

Distance travelled by car Q :

Car Q moves at 10 km/h but stops after 1 hours for t minutes.

$$D_Q = \text{Speed} \times \text{Time}$$

$$D_Q = (30 \text{ km/h}) \times \left(1 + \frac{t}{60}\right) \text{ h}$$

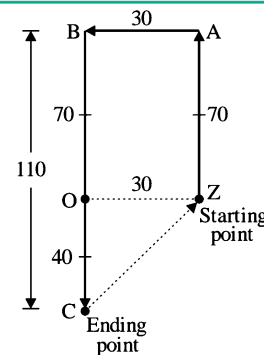
$$37.5 = 30 + \frac{30t}{60}$$

$$37.5 - 30 = \frac{t}{2}$$

$$7.5 = \frac{t}{2}$$

$$t = 15 \text{ minutes}$$

Hence, the correct option is (C).



From point C(EP) to point Z(SP) the minimum distance will be,

$$\begin{aligned} CZ &= \sqrt{OZ^2 + OC^2} \\ &= \sqrt{30^2 + 40^2} = \sqrt{900 + 1600} \\ &= \sqrt{2500} = 50 \text{ km} \end{aligned}$$

Thus, shortest distance from C to starting point is 50 km.

According to the question,

Person is travelling at the speed of 10 km/hr.

So the time taken by him to reach the starting point from C is,

$$\frac{\text{Shortest distance}}{\text{Speed}} = \frac{50 \text{ km}}{10 \text{ km/hr}} = 5 \text{ hr}$$

Hence, the correct option is (B).

2. (C)

Given :

Speed of Train = 60 km/hr

Speed of Bus = 30 km/hr

Speed of Cycle = 10 km/hr

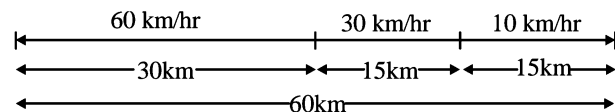
Consider total Distance as LCM of given different speeds i.e. 60 km.

According to the question,

Half journey = 30 km

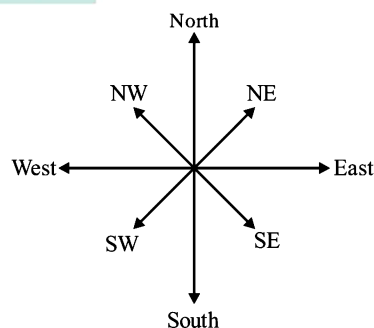
Half of the remaining journey = 15 km

Rest of the journey = 15 km



Engineering Services Examination (ESE)

1. (B)



Basic Directions

According to the given data the figure is shown below :

Since, Average Speed

$$= \frac{\text{Total Distance Covered}}{\text{Total Time Taken}}$$

$$= \frac{60\text{km}}{\frac{1}{2}\text{hr} + \frac{1}{2}\text{hr} + \frac{3}{2}\text{hr}}$$

$$= \frac{60\text{ km}}{5} \times 2$$

Thus, Average Speed = 24 km/hr.

Hence, the correct option is (C).

3. (A)

Total distance to be covered = Sum of lengths of both trains

$$= 120 + 80 = 200\text{m}$$

In case of opposite direction

Relative speed = Sum of speeds

$$= 42 + 30 = 72\text{ km/h}$$

$$\text{Relative speed in m/s} = 72 \times \frac{5}{18} = 20\text{ m/s}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{200}{20} = 10 \text{ seconds}$$

Hence, the correct option is (A).





Work & Time

INTRODUCTION :

To understand the concept of work and time let us take an example.

Example : If 2 men take 10 days to build a wall, 1 man will take 20 days (not 5 days) to build the same wall because man and time are inversely proportional to each other. When men will decrease the number of days then time required to complete the work will increase i.e. $M \propto \frac{1}{D}$ where M and D are number of men and number of days respectively.

If we further break number of days to hours, then total hours = DH , where H is number of hours per day.

Now,
$$M \propto \frac{1}{DH} \quad \dots (i)$$

To elaborate it further, let's say M number of men take D days to build a room. Now, if the work is doubled (they have to build two rooms of same size) in same D number of days, then they have to double their strength or we can say that number of men are directly proportional to the work to be finished. In mathematics, we can write it as,

$$M \propto W \quad \dots (ii)$$

where W is the work to be finished.

From equation (i) and (ii),

$$M \propto \frac{1}{DH} \times W$$

Or
$$\frac{MDH}{W} = K \quad \text{where } K \text{ is constant of proportionality}$$

Or
$$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$$

Above equation is also known as **Work Equivalence**.

METHOD TO SOLVE WORK AND TIME PROBLEMS :**1. Concept of unit time :**

If A does a work in 10 days, then what is the one- day work done by A?

$$\text{Unit time work} = \frac{1}{\text{Total time taken}}$$

Therefore, one day work done by A is $\frac{1}{10}$.

2. LCM Approach :

In this type of approach the total work is considered as the LCM of the time taken by the individuals and then unit time work is calculated. Here the work done is not 1 (unity) but the LCM of the time taken by number of persons.

IMPORTANT POINTS :

1. If A and B can do a piece of work in X and Y days respectively, while working alone. They will together take $\frac{X \times Y}{(X + Y)}$ days to complete it.
2. If A, B, C can do a piece of work in X, Y, Z days respectively while working alone. They will together take $\frac{X \times Y \times Z}{X \times Y + Y \times Z + Z \times X}$ days to finish it.
3. Number of persons employed to do the work is directly proportional to the amount of work done (More the number of persons employed, more the work done).
4. The number of days is directly proportional to the work done (More the number of days for which a work was done, more shall be the total amount of work done).
5. The number of persons employed is inversely proportional to the number of days required to finish a work. (More the number of persons employed, less will be the time required to finish the work)
6. Two persons A and B working together, can finish a piece of work in M days. If A can finish the job in X days by working alone, then B will finish the job by working alone in $\frac{M \times X}{X - M}$ days.
7. If A can complete $\frac{a}{b}$ part of a work in X days, then $\frac{c}{d}$ part of the work will be done in $\frac{b \times c \times X}{a \times d}$ days.
8. If A can finish a work in X days and B is K times as efficient as A, then the time required by both A and B working together to finish the job will be $\frac{X}{1 + K}$.
9. A is K times as good a worker as B and takes X days less than B to finish the work. Then the amount of time required by A and B working together is $\frac{K \times X}{K^2 - 1}$.

PIPE AND CISTERNS :

Pipes and Cisterns problems are almost the same as those of time and work problems. Thus, if a pipe fills a tank in 6 hrs, then the pipe fills $\frac{1}{6}$ th of the tank in 1 hour. The only difference with pipes and cisterns problems is that there are outlets as well as inlets. Thus, there is a concept of negative work too.

Inlet : A pipe connected with a tank (or a cistern or a reservoir) is called an inlet, if it fills the tank. The work done by this is taken as positive work.

Outlet : A pipe connected with a tank is called an outlet, if it empties the tank and the work done by this is taken as the negative work.

IMPORTANT POINTS :

- Two pipes A and B can fill a cistern in X and Y hours respectively, while working alone. If both the pipes are opened together, then the time taken to fill the cistern will be $\frac{X \times Y}{X + Y}$.
- Three pipes A , B and C can fill a cistern in X , Y and Z hours respectively, while working alone. If all the three pipes are opened together, the time taken to fill the cistern will be $\frac{X \times Y \times Z}{XY + YZ + ZX}$.
- If a cistern generally takes X minutes to be filled by a pipe but due to a leak, it takes Y extra minutes to be filled, then the amount of time in which the leak can empty the full cistern with the inlet pipe not in operation will be $\left(\frac{X^2 + XY}{Y} \right)$.
- A cistern has a leak which can empty it in X hours. A pipe which admits Y litres of water per hour into the cistern is turned on and now the cistern is emptied in Z hours. Then the capacity of the cistern is $\frac{X \times Y \times Z}{Z - X}$.
- The expression for filling pipe which can fill p_1 part of cistern in t_1 minutes and p_2 part in t_2 minutes is $\frac{t_1}{p_1} = \frac{t_2}{p_2}$.
- The expression for emptying pipe which can empty e_1 part of cistern in t_1 minutes and e_2 part in t_2 minutes is $\frac{t_1}{e_1} = \frac{t_2}{e_2}$.

Example 1

35 men complete a piece of work in 16 days and 20 women complete the same piece of work in 30 days. What is the ratio of the amount of work done by 40 men in 1 day to the amount of work done by 15 women in 1 day?

Solution :

Given :

- 35 men complete the work in 16 days.
- 20 women complete the same piece of work in 30 days.

1 men completes the work in 16×35 days,

35 men complete the work in $\frac{16 \times 35}{40} = 14$ days.

1 women completes the same piece of work in 20×30 days.

15 women can complete the work in $(20 \times 30) / 15 = 40$ days.

$$\text{Ratio} = \frac{1}{14} : \frac{1}{40} = 40 : 14 = 20 : 7$$

Hence, the ratio of the amount of work done by 40 men in 1 day to the amount of work done by 15 women in 1 day is 20 : 7.

Example 2

15 men can complete a work in 8 days. Same work can be completed by 20 women in 12 days. Two groups are made containing 10 men and 15 women respectively. Both groups work alternately for 4 days each starting with men's group. In how many days the work will get completed?

Solution :

Given :

(i) 15 men can complete a work in 8 days

(ii) 20 women can complete a work in 12 days

1 man can complete the work in $\frac{1}{15 \times 8}$ days

1 woman can complete the work in $\frac{1}{20 \times 12}$ days

10 men can complete the work in four days $= \frac{10 \times 4}{15 \times 8} = \frac{1}{3}$ part

15 women can complete the work in four days $= \frac{15 \times 4}{20 \times 12} = \frac{1}{4}$ part

In 1st 4 days work done by men $= 1/3$, in next 4 days work done by women $= 1/4$, in next 4 days men's turn so they did $1/3$ work.

$$\text{Up to now work done is } \frac{1}{3} + \frac{1}{4} + \frac{1}{3} = \frac{11}{12}$$

$$\text{Remaining work} = 1 - \frac{11}{12} = \frac{1}{12}$$

Now women's turn,

15 women can complete a work in 16 days.

So, $1/12$ work in $1/12 \times 16 = \frac{4}{3}$ days $= \frac{4}{3}$ days

So, total days $= 4 + 4 + 4 + \frac{4}{3} = \frac{40}{3} = 13\frac{1}{3}$ days

Hence, the work will get completed in $13\frac{1}{3}$ days.

2010 IIT Guwahati

- 7.1** 5 skilled workers can build a wall in 20 days; 8 semi-skilled worker can build a wall in 25 days; 10 unskilled workers can build a wall in 30 days. If a team has 2 skilled, 6 semi-skilled and 5 unskilled workers, how long will it take to build the wall? [All branches]
- (A) 20 days (B) 18 days
(C) 16 days (D) 15 days

2011 IIT Madras

- 7.2** A transporter receives the same number of orders each day. Currently, he has some pending orders (backlog) to be shipped. If he uses 7 trucks, then at the end of the 4th day he can clear all the orders. Alternatively, if he uses only 3 trucks, then all the orders are cleared at the end of the 10th day. What is the minimum number of trucks required so that there will be no pending order at the end of the 5th day?
- [AR, BT, CE, CH, CS, ME, PH, PI]
- (A) 4 (B) 5
(C) 6 (D) 7
- 7.3** If m students require a total of m pages of stationery in m days, then 100 students will require 100 pages of stationery in :
- [GG, TF]
- (A) 100 days (B) $m/100$ days
(C) $100/m$ days (D) m days

2013 IIT Bombay

- 7.4** The current erection cost of a structure is Rs.13,200. If the labour wages per day increase by $\frac{1}{5}$ of the current wages and

the working hours decrease by $\frac{1}{24}$ of the current period, then the new cost of erection in Rs. is [CS, ME, PI]

(A) 16,500 (B) 15,180
(C) 11,000 (D) 10,120

2016 IISc Bangalore

- 7.5** P , Q , R and S are working on a project. Q can finish the task in 25 days, working alone for 12 hours a day. R can finish the task in 50 days, working alone for 12 hours per day. Q worked 12 hours a day but took sick leave in the beginning for two days. R worked 18 hours a day on all days. What is the ratio of work done by Q and R after 7 days from the start of the project? [EC-1, ME-1]
- (A) 10 : 11 (B) 11 : 10
(C) 20 : 21 (D) 21 : 20
- 7.6** S , M , E and F are working in shifts in a team to finish a project. M works with twice the efficiency of others but for half as many days as E worked. S and M have 6 hour shifts in a day, whereas E and F have 12 hours shifts. What is the ratio of contribution of M to contribution of E in the project? [EC-2, ME-3]
- (A) 1 : 1 (B) 1 : 2
(C) 1 : 4 (D) 2 : 1
- 7.7** Ananth takes 6 hours and Bharath takes 4 hours to read a book. Both started reading copies of the book at the same time. After how many hours is the number of pages to be read by Ananth, twice that to be read by Bharath? Assume Ananth and Bharath read all the pages with constant pace. [AG, CE-2, EY, MT, PI]
- (A) 1 (B) 2
(C) 3 (D) 4

2017 IIT Roorkee

- 7.8** 1200 men and 500 women can build a bridge in 2 weeks. 900 men and 250 women will take 3 weeks to build the same bridge. How many men will be needed to build the bridge in one week?

[AE, EC-2, MA, MT, PE, PH]

- (A) 3000 (B) 3300
(C) 3600 (D) 3900
- 7.9** Two machines M1 and M2 are able to execute any of four jobs P, Q, R, and S. The machines can perform one job on one object at a time. Jobs P, Q, R and S take 30 minutes, 20 minutes, 60 minutes and 15 minutes each respectively. There are 10 objects each requiring exactly 1 job. Job P is to be performed on 2 objects, Job Q on 3 objects, Job R on 1 object and Job S on 4 objects. What is the minimum time needed to complete all the job?
- 7.10** X bullocks and Y tractors take 8 days to plough a field. If we halve the number of bullocks and double the number of tractors, it takes 5 days to plough the same field. How many days will it take X bullocks to plough the field?

[CE-1, CH, MN]

- (A) 2 hours (B) 2.5 hours
(C) 3 hours (D) 3.5 hours

[AG, GG, ME-2]

- (A) 30 (B) 35
(C) 40 (D) 45

2018 IIT Guwahati

- 7.11** Seven machines take 7 minutes to make 7 identical toys. At the same time rate how many minutes would it take for 100 machines to make 100 toys?

[EY, ME-1, PE, XE, XL]

- (A) 1 (B) 7
(C) 100 (D) 700

- 7.12** A contract is to be completed in 52 days and 125 identical robots were employed, each operational for 7 hours a day. After 39 days, five-seventh of the work was completed. How many additional robots would be required to complete the work on time, if each robot is now operational for 8 hours a day? [AE, MA, ME-2, PI]

- (A) 50 (B) 89
(C) 146 (D) 175

2019 IIT Madras

- 7.13** An oil tank can be filled by pipe X in 5 hours and pipe Y in 4 hours, each pump working on its own. When the oil tank is full and the drainage hole is open, the oil is drained in 20 hours. If initially the tank was empty and someone started the two pumps together but left the drainage hole open, how many hours will it take for the tank to be filled? [CE-2]

(Assume that the rate of drainage is independent of the Head)

- (A) 4.00 (B) 1.50
(C) 2.00 (D) 2.50

- 7.14** It would take one machine 4 hours to complete a production and another machine 2 hours to complete the same order. If both machine work simultaneously at their respective constant rates, the time taken to complete the same order is _____ hours. [EC]

- (A) $\frac{4}{3}$ (B) $\frac{3}{4}$
(C) $\frac{2}{3}$ (D) $\frac{7}{3}$

- 7.15** It takes two hours for a person X to mow the lawn. Y can mow the same lawn in four hours. How long (in minutes) will it

take X and Y , if they work together to mow the lawn? [EE]

- (A) 60 (B) 80
(C) 90 (D) 120

- 7.16** A worker noticed that hour hand on the factory clock had moved by 225 degree during her stay at the factory. For how long did she stay in the factory?

[CY, ME-1, MN]

- (A) 3.75 hours
(B) 4 hours and 15 minutes
(C) 7.5 hours
(D) 8.5 hours

- 7.17** Two pipes P and Q can fill a tank in 6 hours and 9 hours respectively, while a third pipe R can empty the tank in 12 hours. Initially, P and R are open for 4 hours. Then P is closed and Q is opened. After 6 more hours R is closed. The total time taken to fill the tank (in hours) is _____. [ME-2, TF, XE, XL]

- (A) 13.50 (B) 15.50
(C) 16.50 (D) 14.50

2020 IIT Delhi

- 7.18** It was estimated that 52 men can complete a strip in a newly constructed highway connecting cities P & Q in 10 days. Due to an emergency, 12 men were sent to another project. How many number of days, more than the original estimate, will be required to complete the strip? [CY, ME-2, PI]

- (A) 3 days (B) 10 days
(C) 5 days (D) 13 days

2022 IIT Kharagpur

- 7.19** Pipes P and Q can fill a storage tank in full with water in 10 and 6 minutes, respectively. Pipe R draws the water out

from the storage tank at a rate of 34 liters per minute. P , Q and R operate at a constant rate.

If it takes one hour to completely empty a full storage tank with all the pipes operating simultaneously, what is the capacity of the storage tank (in liters)?

[IN, CH, PI]

- (A) 60.0 (B) 120.0
(C) 26.8 (D) 127.5

- 7.20** For the past m days, the average daily production at a company was 100 units per day.

If today's production of 180 units changes the average to 110 units per day, what is the value of m ?

[ME-2]

- (A) 18 (B) 10
(C) 7 (D) 5

Engineering Services Examination (ESE)

- 1.** Five men can paint a building in 20 days, 8 Women can paint the same building in 25 days and 10 Boys can paint it in 30 days. If a team has 2 men, 6 Women and 5 Boys, how long will it take to paint the building?

- (A) 12 days (B) 13 days
(C) 14 days (D) 15 days

[ESE 2017]

- 2.** A group of workers estimate to finish a work in 10 days, but 5 workers could not join the work, if the rest of them finished the work in 12 days, the number of members present in the team originally is:

- (A) 50 (B) 45
(C) 35 (D) 30

[ESE 2017]

3. A is twice as good a workman as B and together, they finish a piece of work in 18 days. In how many days will A alone finish the work ?

(A) 28 days (B) 30 days
(C) 27 days (D) 29 days

[ESE 2021]

4. A tank can be filled by 20 buckets each of capacity 13.5 litres. If the capacity of each bucket be 9 litres, how many buckets will fill the same tank ?

(A) 30 (B) 25
(C) 20 (D) 15

[ESE 2022]

5. Three pipes A, B and C can fill a tank in 6 hours. When the tank was empty, all the three pipes were turned on and they worked together for 2 hours, at that instant, pipe C was closed and the pipes A and B continued to work to fill the tank. It took a total of 7 hours from start to fill the tank this way. If pipe C alone is working from the start, the time it takes will be

(A) 10 hours (B) 14 hours
(C) 30 hours (D) 45 hours

[ESE 2025]

6. A builder decided to build a farmhouse in 40 days. He employed 100 men in the beginning and 100 more after 35 days and completed the construction in the stipulated time. If he had not employed additional men, how many days behind the schedule the construction would have been finished ?

(A) 2 days (B) 5 days
(C) 10 days (D) 15 days

[ESE 2025]

7. A concrete post, planted vertically in a lake is seen with its top 7 m projecting above the water surface. If its $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{1}{8}$ parts of the length are in water, mud and sand respectively, the length of the post will be

(A) 24 m (B) 27 m
(C) 36 m (D) 42 m

[ESE 2025]

8. A construction work is to be completed in 46 days by 117 men at work, 8 hours being the working period per day. After 33 days, it is found that only of the work is completed. If the working time is increased to 9 hours/day, the number of additional men required to complete the work in 46 days period will be

(A) 72 men (B) 81 men
(C) 90 men (D) 99 men

[ESE 2025]

9. External companies are enabled to view some of a particular company's information and such sharing of information is known as

(A) Ethernet (B) Internet
(C) Extranet (D) Fibrenet

[ESE 2025]

10. If 8 children and 8 men complete certain job in 6 days and if each child takes twice the time taken by a man to finish the same work, in how many days 8 men will finish the same work ?

(A) 12 days (B) 10 days
(C) 9 days (D) 8 days

[ESE 2025]

11. Read the following information and answer the question that follows :

1. Six scientists A, B, C, D, E and F of the disciplines, Chemistry, Botany, Zoology, Physics, Mathematics and Geology but not necessarily in this order, want to demonstrate an integrated experiment based on inter-disciplinary approach.
2. Each day only one scientist will perform the part of his discipline.
3. The experiment will start on Monday and end on Sunday. One day will be the rest day, which otherwise is a part of the experiment.
4. Chemistry will be on the very next day of Geology.
5. A, who is a Mathematician, can perform either on a second day or the

last day but should not be immediately preceded by Botany.

6. C will demonstrate on the third day and Physics will be on the fifth day.
7. E, who is a Zoologist, performs on the second day.
8. B performs on Monday and the day after F's performance will be the rest day.

Which one of the following is the correct sequence of scientists performing ?

- (A) DBCAFE (B) BEDCFA
(C) BECDFA (D) CBEFDA

[ESE 2026]

Answers		Work & Time							
7.1	D	7.2	C	7.3	D	7.4	B	7.5	C
7.6	B	7.7	C	7.8	C	7.9	A	7.10	A
7.11	B	7.12	MTA	7.13	D	7.14	A	7.15	B
7.16	C	7.17	D	7.18	A	7.19	B	7.20	C
Engineering Services Examination (ESE)									
1.	D	2.	D	3.	C	4.	A	5.	D
6.	B	7.	A	8.	B	9.	C	10.	C
11.	*								

Explanations		Work & Time							
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7.1 (D)

Per day work or rate of 5 skilled workers = $\frac{1}{20}$

Per day work or rate of one skilled worker

$$= \frac{1}{5 \times 20} = \frac{1}{100}$$

Similarly, per day work or rate of 8 semi-skilled

$$\text{workers} = \frac{1}{25}$$

Per day work or rate of one semi-skill worker

$$= \frac{1}{8 \times 25} = \frac{1}{200}$$

and per day work or rate of 10 unskilled workers

$$= \frac{1}{30}$$

Per day work or rate of one unskilled worker

$$= \frac{1}{10 \times 30} = \frac{1}{300}$$

Thus total per day work of 2 skilled, 6 semi-skilled and 5 unskilled workers

$$= \frac{2}{100} + \frac{6}{200} + \frac{5}{300} = \frac{12+18+10}{600}$$

$$= \frac{40}{600} = \frac{1}{15}$$

Thus, time to complete the work is 15 days.

Hence, the correct option is (D).

7.2 (C)

Given :

- (i) The transporter receives same number of order each day and he currently has pending orders. Let x be the number of daily received order and y be the number of pending orders.
- (ii) Use of 7 trucks each day finishes all orders in 4th day.

Total number of received order in 4 days

$$= x + x + x + x$$

$$= 4x$$

Including pending order y , total order = $4x + y$

Total number of trucks used = $7 + 7 + 7 + 7 = 28$

$$\text{i.e. } 4x + y = 28 \quad \dots (i)$$

Use of 3 trucks each day finishes all orders in 10th day.

Total number of received order in 10 days = $10x$

Including pending order, total order = $10x + y$

Total number of trucks used = $10x + y = 30$

$$\text{i.e. } 10x + y = 30 \quad \dots (ii)$$

From equations (i) and (ii),

$$x = 0.33$$

$$y = 26.66$$

Total number of order in 5 days = $5x + y$

Number of trucks required in 5 days = $5 \times n$

Where, n = number of trucks used each day

i.e. $5x + y = 5n$

$$5 \times 0.33 + 26.66 = 5n$$

$$n = 5.66$$

$$n \approx 6$$

Hence, the correct option is (C).

7.3 (D)

Given : $W_1 = m$ pages, $W_2 = 100$ pages,

$$D_1 = m \text{ days, } D_2 = ?$$

$$M_1 = m \text{ students, } M_2 = 100 \text{ students,}$$

$$\frac{W_1}{M_1 D_1} = \frac{W_2}{M_2 D_2}$$

Therefore, $\frac{m}{m \times m} = \frac{100}{100 \times D_2}$

$$D_2 = m \text{ days}$$

Thus, m days required.

Hence, the correct option is (D).

Key Point

For different works,

$$\frac{W_1}{M_1 D_1} = \frac{W_2}{M_2 D_2}$$

W_1 = Works of 1st group

W_2 = Works of 2nd group

D_1 = Working Days of 1st group

D_2 = Working days of 2nd group

M_1 = Workers of 1st group

M_2 = Workers of 2nd group

7.4 (B)

Let 'X' be the labour wages and 'R' be the working hours.

Now, total cost = $X \times R = 13200$

Increase in wages = $\frac{1}{5}$ i.e. 20%

$$\text{So, revised wages} = X + \frac{X}{5} = \frac{6X}{5}$$

$$X' = \frac{6X}{5}$$

$$\text{Decrease in labour time} = \left(\frac{1}{24} \right) \%$$

$$\text{So, revised time} = \left(R - \frac{R}{24} \right)$$

$$R' = \frac{23}{24} R$$

Therefore, revised total cost

$$X' R' = 1.2 X \times \frac{23}{24} R = 1.15 XR$$

$$X' R' = 1.15 \times 13200 = 15180$$

Hence, the correct option is (B).

7.5 (C)

Given :

Q can finish the work in 25 days $\times$ 12 hours
= 300 hrs

R can finish the work in 50 days $\times$ 12 hours
= 600 hrs

So, **Q** is twice efficient as **R**.

Now, **Q** worked only for 5 days at a rate of 12 hrs/day. So for 60 hours of his work (Total work for **Q** i.e. 300 hrs) he will do only $\frac{1}{5}$ of work $\left(\frac{60}{300} = \frac{1}{5} \right)$.

While **R** worked for all 7 days at a rate of 18 hrs/day.

So, **R** will do $18 \times 7 = 126$ of his work (Total work for 600 hrs)

R will do $\left(\frac{126}{600} = 0.21 \right)$ of his work

So, required ratio,

$$\left(\frac{1}{5} : \frac{126}{600} \right) = 120 : 126 = 20 : 21$$

Hence, the correct option is (C).

7.6 (B)**Given :**Efficiency of $M = 2 \times (\text{Efficiency of } S, E \text{ and } F)$ Let M works for x days then E works for $2x$ days.Contribution of M in the project

$$= x \text{ days} \times 6 \text{ hrs} \times 2$$

Contribution of E in the project

$$= 2x \text{ days} \times 12 \text{ hrs} \times 1$$

Contribution of M : Contribution of E

$$x \times 6 \times 2 : 2x \times 12 \times 1$$

$$1 : 2$$

Hence, the correct option is (B).

Key Point

Number of hours per day, working days and efficiency are the 3 attributes of contribution to work given in the problem. So these 3 must be multiplied to compare the individual's contribution.

7.7 (C)**Given :**

(i) Ananth takes 6 hours to read a book

(ii) Bharath takes 4 hours to read a book

L.C.M. = 12

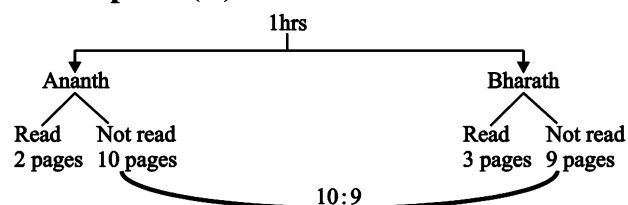
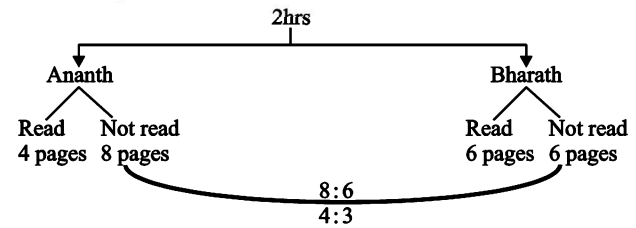
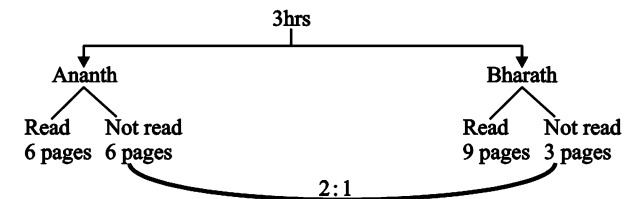
The number of pages read by Ananth and Bharath must be 12 (or) multiple of 12 only.

If Ananth read 12 number of pages in 6 hrs,

$$\text{Then, } 1 \text{ hr} = \frac{12}{6} = 2 \text{ pages}$$

If Bharath read 12 number of pages in 4 hrs,

$$\text{Then, } 1 \text{ hr} = \frac{12}{4} = 3 \text{ pages}$$

From option (A) :**From option (B) :****From option (C) :**

Therefore, after 3 hours is the number of pages to be read by Ananth, twice that to be read by Bharath.

Hence, the correct option is (C).

7.8 (C)**Given :**

$$1200 \text{ men} + 500 \text{ women} = 2 \text{ weeks}$$

$$900 \text{ men} + 250 \text{ women} = 3 \text{ weeks}$$

Let, 'x' men can finish entire work in 1 week.

and 'y' women can finish entire work in 1 week.

$$1200 \times \frac{1}{x} + 500 \times \frac{1}{y} = \frac{1}{2} \quad \dots(i)$$

$$900 \times \frac{1}{x} + 250 \times \frac{1}{y} = \frac{1}{3} \quad \dots(ii)$$

Solving equations (i) and (ii),

$$x = 3600, y = 3000$$

Hence, the correct option is (C).

7.9 (A)**Given :**

(i) Number of machines = 02 i.e. M1 and M2

(ii) Number of jobs = 04 i.e. P, Q, R and S

(iii) Number of objects = 10

(iv) Two objects need job P, 3 objects need job Q, 1 objects needs job R and 4 objects need job S.

- (v) Machines can perform one job at one object at a time.

In the first hour, machine M1 will perform job P on two objects (30 minutes each) and M2 will perform job R on one object.

In the second hour, M1 will perform job Q on three objects (20 minutes each) and M1 will perform job S on four objects (15 minutes each). Therefore, all jobs can be performed on all 10 objects within 2 hours (one job on each object).

Hence, the correct option is (A).

7.10 (A)

Given :

- (i) X bullocks and Y tractors take 8 days to plough the field.
- (ii) $\frac{X}{2}$ bullocks and $2Y$ tractors take 5 days to plough the field.

According to given data,

$$1 \text{ day of work by } X \text{ and } Y = \frac{1}{8}$$

$$X + Y = \frac{1}{8} \quad \dots (i)$$

$$1 \text{ day of work by } \frac{X}{2} \text{ and } 2Y = \frac{1}{5}$$

$$\frac{X}{2} + 2Y = \frac{1}{5} \quad \dots (ii)$$

From equations (i) and (ii),

$$X = \frac{1}{30}, Y = \frac{11}{120}$$

1 day of work by,

$$X = \frac{1}{30}$$

So, X will plough the complete field in 30 days.

Hence, the correct option is (A).

7.11 (B)

$$\text{Concept : } \frac{DMTE}{W} = C \text{ (Constant)}$$

Where, D = Days, M = Man power/machines

T = Time, E = Efficiency, W = Work

$$\text{So, } \frac{M_1 T_1}{W_1} = \frac{M_2 T_2}{W_2}$$

$$\frac{7 \times 7}{7} = \frac{100 \times T_2}{100}$$

$$T_2 = 7 \text{ min}$$

Hence, the correct option is (B).

7.12 MTA

Given :

- (i) Work has to be completed in 52 days using 125 robots each working 7 hours/day.
- (ii) 39 days later, five-seventh of the work is completed.

Then, work done in 39 days = $125 \times 7 \times 39$

$$\frac{5}{7} W = 125 \times 7 \times 39$$

$$W = 47775 \text{ robot/hours}$$

$$\text{So, left work} = W - \frac{5}{7} W$$

$$= \frac{2}{7} W = 13650 \text{ robot/hours}$$

According to question, for the next 13 days robots will work for 8 hours/day. So,

$$13 \times x \times 8 = 13650$$

$$x = 131.25$$

Additional robots required,

$$= 131.25 - 125 = 6.25 \approx 7$$

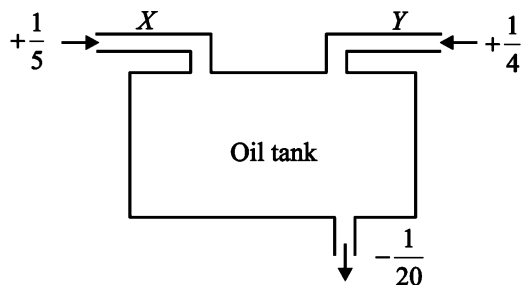
Note : None of the options match the correct answer. For this question, **MTA (Marks to all)** was given by **IIT Guwahati**.

7.13 (D)

Given :

- (i) Pipe X fills the oil tank in 5 hours i.e. in one hour it fills $\frac{1}{5}$ th of tank.

- (ii) Pipe Y fills the oil tank in 4 hours i.e. in one hour it fills $\frac{1}{4}$ th of tank.
- (iii) The drainage drains the tank in 20 hours i.e. it drains $\frac{1}{20}$ th of tank in 1 hours.
- (iv) If both pipes and drainage are open then,



In one hour, the tank will be filled by

$$\frac{1}{5} + \frac{1}{4} - \frac{1}{20} = \frac{8}{20} \text{ part}$$

So, it will take $\frac{20}{8}$ hours i.e. 2.5 hours to fill the tank.

Hence, the correct option is (D).

7.14 (A)

Given : The first machine takes 4 hours and second machine takes 2 hours to complete the work.

$$\text{Work in 1 hour by machine A} = \frac{1}{4}$$

$$\text{Work in 1 hour by machine B} = \frac{1}{2}$$

$$\text{Work in 1 hour by both A and B} = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}$$

So, $\frac{3}{4}$ part of work is done in 1 hour.

$$1 \text{ complete work is done in } \frac{1}{3/4} = \frac{4}{3} \text{ hours}$$

Hence, the correct option is (A).

7.15 (B)

Given :

- (i) X can mow the lawn in 2 hours i.e. X's 1 hour work = $\frac{1}{2}$
- (ii) Y can mow the lawn in 4 hours i.e. Y's 1 hour work = $\frac{1}{4}$

Total work done by X and Y in one hour,

$$= \left(\frac{1}{2} + \frac{1}{4} \right) = \frac{3}{4}$$

$$\text{Total time required} = \frac{1}{\left(\frac{3}{4} \right)} = \frac{4}{3} \text{ hours} = 80 \text{ min}$$

Hence, the correct option is (B).

7.16 (C)

Given : The angle by which hour hand turned $(\theta) = 225^\circ$

Since, the angle turned by hour hand in one hour

$$= \frac{360^\circ}{12} = 30^\circ$$

So, the working time of worker

$$= \frac{\theta}{30^\circ} = \frac{225^\circ}{30^\circ} = 7.5 \text{ hour}$$

Hence, the correct option is (C).

7.17 (D)

Given :

- (i) In 1 hour P can fill = $\frac{1}{6}$
- (ii) In 1 hour Q can fill = $\frac{1}{9}$
- (iii) In 1 hour R can empty = $\frac{1}{12}$

$$\text{In 4 hour (P + R) can fill} = 4 \times \left(\frac{1}{6} - \frac{1}{12} \right) = \frac{1}{3}$$

In 6 hour ($Q + R$) can fill $= 6 \times \left(\frac{1}{9} - \frac{1}{12} \right) = \frac{1}{6}$

In 10 hour tank can fill $= \frac{1}{3} + \frac{1}{6} = \frac{1}{2}$

Remaining part of tank $= 1 - \frac{1}{2} = \frac{1}{2}$

$\frac{1}{2}$ tank Q can fill $= \frac{1}{2} \times 9 = 4.5$ hour

Total time $= 10 + 4.5 = 14.5$ hours

Hence, the correct option is (D).

7.18 (A)

Given : 52 men can complete a strip in 10 days

If 12 men were sent to another project then

$52 - 12 = 40$ men left

Work completed by 40 men is given by,

$$52 \times 10 = 40x$$

$$x = 13$$

So, number of days required more than the original estimate $= 13 - 10 = 3$.

Hence, the correct option is (A).

7.19 (B)

Given : Pipe P can fill a storage tank in 10 minutes.

Pipe Q can fill same storage tank in 5 minutes.

Pipe R draws a full storage tank at a rate of 34 liters per minutes.

Pipes P, Q and R can empty a full storage tank while working simultaneously in 60 minutes.

Let, the capacity of a storage tank is x

Amount of water fills in 1 minute by Pipe

$$P = \frac{x}{10} \text{ liters}$$

Amount of water fills in 1 minute by Pipe $Q = \frac{x}{6}$

liters

Amount of water drawn in 1 minute by Pipes P, Q and R is

$-\frac{x}{60}$ liters (Negative sign is used in outlet or leakage case)

So, amount of water drawn by only Pipe R is

Amount of water drawn by Pipes P, Q and R –
Amount of water filled by Pipes P and Q

$$= -\frac{x}{60} - \left(\frac{x}{6} + \frac{x}{10} \right) \text{ liters} = -\frac{x}{60} - \left(\frac{16x}{60} \right) \text{ liters}$$

$$= -\left(\frac{17x}{60} \right) \text{ liters}$$

Total time taken by Pipe R to draw a storage

$$\text{tank} = \frac{\text{Tank capacity}}{\text{Drawn rate of Pipe } R}$$

Total time taken by Pipe R to draw a storage

$$\text{tank} = \frac{x}{\left(\frac{17x}{60} \right)} \text{ min}$$

Total time taken by Pipe R to draw a storage

$$\text{tank} = \frac{60}{17} \text{ min}$$

Amount of water drawn by R in one minute = 34 liters

Amount of water on full storage tank drawn by

$$R \text{ in } \left(\frac{60}{7} \right) \text{ min} = 34 \times \frac{60}{17} \text{ liter} = 120 \text{ liters}$$

Hence, the correct option is (B).

7.20 (C)

Average production

$$= \frac{\text{all production till to day}}{m} = 100$$

According today, average production

$$= \frac{\text{All production till to day} + 180}{m + 1}$$

$$= 100 = \frac{100m + 180}{m + 1}$$

$$= 110m + 110 = 100m + 180 = 10m : 70$$

$$\therefore m = 7$$

Hence, the correct option is (C).

Engineering Services Examination (ESE)**1. (D)****Given :**

Number of days required by 5 men to paint the building = 20 days,

Number of days required by 8 women to paint the building = 25 days,

Number of days required by 10 boys to paint the building = 30 days,

For same work,

$$M_1 D_1 = M_2 D_2$$

1st group 2nd group

Where, M = Number of workers

D = Number of working days

Here, 5 Men $\times$ 20 days =

(2 Men + 6 Women + 5 Boys) $\times$ Days ... (i)

Number of days required by 1 man to paint the building = $20M \times 5D = 100$ days

Number of days required by 1 woman to paint the building = $25W \times 8D = 200$ days

Number of days required by 1 boy to paint the building = $30B \times 10D = 300$ days

Therefore, efficiency of Man, Woman and Boy

1 Man efficiency = 2 Women efficiency

1 Man efficiency = 3 Boys efficiency

From equation (i),

$$5 \times 20 = \left(2M + 3M + \frac{5}{3}M \right) \times \text{days}$$

$$100 = \frac{20}{3} \times \text{days}$$

Days = 15

So, they requires 15 days to paint the building.

Hence, the correct option is (D).

2. (D)**Given :**

Number of estimated days to finish a work by group of workers $D_1 = 10$ days ,

Number of days required to finish a work by other group of workers $D_2 = 12$ days ,

According to the question,

$$M_1 D_1 = M_2 D_2 \quad (\text{For same work})$$

1st group 2nd group

Where, M = Number of workers

D = Number of working days

Let, the number of workers be M ,

Thus, $M \times 10 = (M - 5) \times 12$

$$M \times 5 = (M - 5) \times 6$$

$$M = 30$$

Therefore, the number of members present in team originally is 30.

Hence, the correct option is (D).

3. (C)**Given :****Method 1**

Efficiency of $A = 2 \times$ efficiency of B

They together can complete the whole work in 18 days.

Work = Efficiency $\times$ Time

$$\frac{\text{Efficiency of } A}{\text{Efficiency of } B} = \frac{2}{1}$$

Efficiency of $(A + B) = 3$

Total work = $3 \times 18 = 54$ units

A alone can do this work in $\frac{54}{2}$ days.

The time taken by A to complete the work is 27 days.

Hence, the correct option is (C).

Method 2

$$A \xrightarrow{\frac{1 \text{ day}}{\text{work}}} 2 \text{ unit/day}$$

$$B \xrightarrow{\frac{1 \text{ day}}{\text{work}}} 1 \text{ unit/day}$$

$$A + B \xrightarrow{\frac{1 \text{ day}}{\text{work}}} 3 \text{ unit/day}$$

$$A + B \xrightarrow{\text{work}} 18 \times 3 = 54 \text{ unit}$$

$$\text{Time taken by 'A' alone} = \frac{54}{2} = 27 \text{ days}$$

Hence, the correct option is (C).

4. (A)

$$\text{Total capacity} = 20 \times 13.5 = 270 \text{ liters}$$

$$1 \text{ bucket Capacity} = 9 \text{ liters}$$

$$\text{Buckets to filled tank} = \frac{\text{Total capacity}}{1 \text{ bucket capacity}}$$

$$\text{Buckets to filled tank} = \frac{270}{9} = 30$$

Hence the correct option is (A).

5. (D)

Given :

Pipes A, B and C together fill the tank in 6 hours.

$$\therefore \text{Rate of } A + B + C$$

$$A + B + C = \frac{1}{6}$$

In first 2 hours, all three pipes work.

Tank filled in 2 hours.

$$2 \times \frac{1}{6} = \frac{1}{3}$$

$$\therefore \text{Remaining part of tank}$$

$$1 - \frac{1}{3} = \frac{2}{3}$$

Now pipe C is closed.

$$\text{Pipes A and B fill remaining } \frac{2}{3} \text{ tank in } 7 - 2 =$$

5 hours.

$$\therefore \text{Rate of } A + B$$

$$A + B = \frac{\frac{2}{3}}{5} = \frac{2}{15}$$

$$\text{Now, } C = (A + B + C) - (A + B)$$

$$C = \frac{1}{6} - \frac{2}{15} = \frac{1}{30}$$

Hence, time taken by pipe C alone

$$= \frac{1}{1/30} = 30 \text{ Hours}$$

Hence, the correct option is C.

6. (B)

Total planned lime = 40 days

Initially employed = 100 men

After 35 days, employed 100 more, so total becomes 200 men

Let total days required = x

$$x = 45$$

He would have finished in 45 days but schedule was 40 days. So 5 days behind schedule construction would have been finished.

Hence, the correct option is (B).

7. (A)

Let the length of the post = x

The remaining length above the water.

$$= x \left[1 - \frac{1}{3} - \frac{1}{4} - \frac{1}{6} \right] = x \left[\frac{24 - 8 - 6 - 3}{24} \right]$$

$$= \frac{7x}{24}$$

According to question,

$$\frac{7x}{24} = 7$$

$$x = 24 \text{ m}$$

Hence, the correct option is (A).

8. (B)

Let additional men required = x

$$\frac{M_1 D_1 H_1}{M_2 D_2 H_2} = \frac{W_1}{W_2}$$

$$\frac{117 \times 33 \times 8 \times 3}{(117 + x) \times 13 \times 9 \times 4} = \frac{4/7}{3/7}$$

$$117 + x = \frac{117 \times 33 \times 8 \times 3}{13 \times 9 \times 4 \times 4} = 198$$

$$x = 81 \text{ men}$$

Hence, the correct option is (B).

9. (C)

An Extranet is a private network that allows access to partners, vendors and suppliers or an authorized set of users outside the company, it helps facilitate secure sharing of part of a business's information or operations with external entities.

While Ethernet is a LAN networking technology, Fibernet is fibre based (e.g. Optical fibre) based internet service.

Internet is a global public network.

Hence, the correct option is (C).

10. (C)

$$1m = 2C$$

$$[8C + m] \times 6 = 8m \times x$$

$$[4m + 8m] \times 6 = 8m \times x$$

$$12m \times 6 = 8m \times x$$

$$x = 9$$

Hence, the correct option is (C).

11. (*)

CHAPTER 2 | LOGICAL REASONING

Contents :

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4.	Seating Arrangement	2.224 - 2.233

1

Data Interpretation

2010 IIT Guwahati

- 1.1 Hari (*H*), Gita (*G*), Irfan (*I*) and Saira (*S*) are siblings (i.e. brothers and sisters). All were born on 1st January. The age difference between any two successive siblings (that is born one after another) is less than 3 years. Given the following facts :

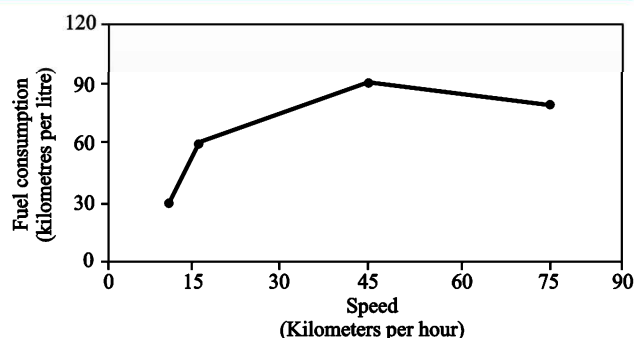
- Hari's age + Gita's age > Irfan's age + Saira's age.
- The age difference between Gita and Saira is 1 year. However, Gita is not the oldest and Saira is not the youngest.
- There are no twins.

In what order were they born (oldest first)? **[All branches]**

- HSIG
- SGHI
- IGSH
- IHSG

2011 IIT Madras

- 1.2 The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below.



The distances covered during four laps of the journey are listed in the table below :

Lap	Distance (Kilometers)	Average Speed (Kilometers per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

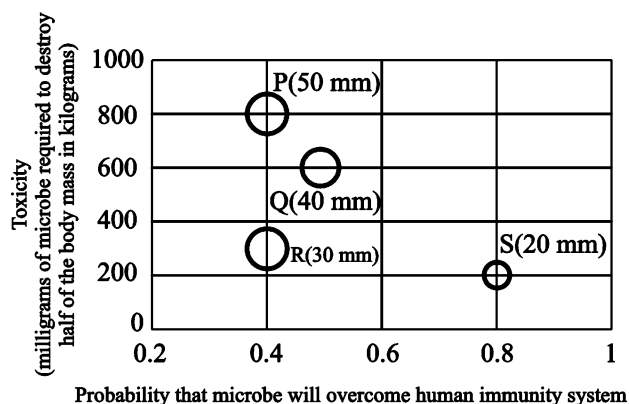
From the given data, we can conclude that the fuel consumed per kilometers was least during the lap

[AG, CY, EC, EE, IN, MA, MT, XE, XL]

- P
- Q
- R
- S

- 1.3 P, Q, R and S are four types of dangerous microbes recently found in a human habitat. The area of each circle with its diameter printed in brackets represents the growth of a single microbe surviving human immunity system within 24 hours of entering the body. The danger to human beings varies proportionately

with the toxicity, potency and growth attributed to a microbe shown in the figure below,



A pharmaceutical company is contemplating the development of a vaccine against the most dangerous microbe. Which microbe should the company target in its first attempt?

[AR, BT, CE, CH, CS, ME, PH, PI]

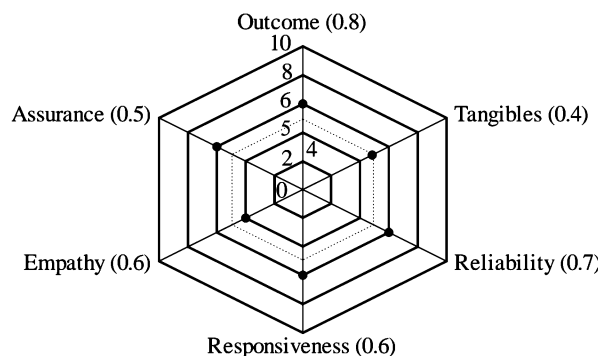
- (A) P (B) Q
(C) R (D) S

- 1.4 Three sisters (R, S, and T) received a total of 24 toys during Christmas. The toys were initially divided among them in a certain proportion. Subsequently, R gave some toys to S which doubled the share of S. Then S in turn gave some of her toys to T, which doubled T's share. Next, some of T's toys were given to R, which doubled the number of toys that R currently had. As a result of all such exchanges, the three sisters were left with equal number of toys. How many toys did R have originally? [GG, TF]

- (A) 8 (B) 9
(C) 11 (D) 12

- 1.5 The quality of services delivered by a company consists of six factors as shown below in the radar diagram. The dots in the figure indicate the score for each

factor on a scale of 0 to 10. The standardized coefficient for each factor is given in the parentheses. The contribution of each factor to the overall service quality is directly proportional to the factor score and its standardized coefficient.

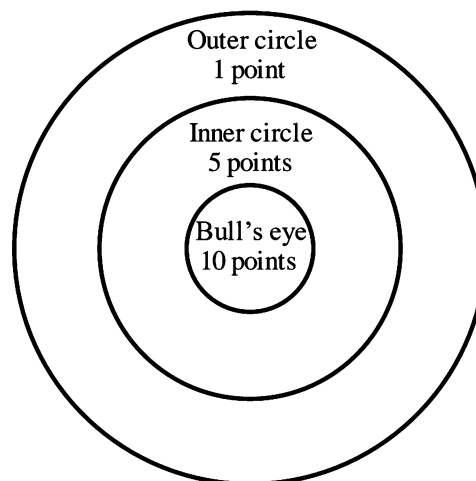


The lowest contribution among all the above factors to the overall quality of services delivered by the company is

[GG, TF]

- (A) 10% (B) 20%
(C) 24% (D) 40%

- 1.6 Four archers P, Q, R and S try to hit a bull's eye during a tournament consisting of seven rounds. As illustrated in the figure below, a player receives 10 points for hitting the bulls' eye, 5 points for hitting within the inner circle and 1 point for hitting within the outer circle.



The final scores received by the players during the tournament are listed in the table below.

Round	P	Q	R	S
1	1	5	1	10
2	5	10	10	1
3	1	1	1	5
4	10	10	1	1
5	1	5	5	10
6	10	5	1	1
7	5	10	1	1

The most accurate and the most consistent players during the tournament are respectively

[AE, MN]

- (A) P and S (B) Q and R
(C) Q and S (D) R and Q

2012 IIT Delhi

- 1.7 Given the sequence of terms, AD CG FK JP, the next term is

[BT, CE, CH, CS, ME, PH, PI]

- (A) OV (B) OW
(C) PV (D) PW

2013 IIT Bombay

- 1.8 Following table gives data on tourists from different countries visiting India in the year 2011.

Country	Number of Tourists
USA	2000
England	3500
Germany	1200
Italy	1100
Japan	2400
Australia	2300
France	1000

Which two countries contributed to the one third of the total number of tourists who visited India in 2011?

[AE, AG, BT, CH, CY, MN, XE, XL]

- (A) USA and Japan
(B) USA and Australia
(C) England and France
(D) Japan and Australia

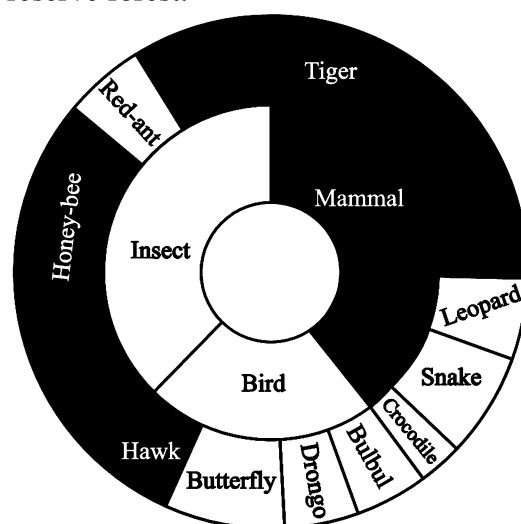
- 1.9 Abhishek is elder to Savar. Savar is younger to Anshul.
Which of the given conclusions is logically valid and is inferred from the above statements?

[AR, CE, GG, MA, MT, PH, TF]

- (A) Abhishek is elder to Anshul
(B) Anshul is elder to Abhishek
(C) Abhishek and Anshul are of the same age
(D) No conclusions follows

2014 IIT Kharagpur

- 1.10 The multi-level hierarchical pie chart shows the population of animals in a reserve forest.



The correct conclusions from this information are :

- (i) Butterflies are birds.
(ii) There are more tigers in this forest than red ants.
(iii) All reptiles in this forest are either snakes or crocodiles.
(iv) Elephants are the largest mammals in this forest.

[EC-3, ME-3]

- (A) (i) and (ii) only.
 (B) (i), (ii), (iii) and (iv).
 (C) (i), (iii) and (iv) only.
 (D) (i), (ii) and (iii) only.

1.11 If “KCLFTSB” stands for “best of luck” and “SHSWDG” stands for “good wishes”, which of the following indicates “ace the exam”? [EC-4, ME-4]

- (A) MCHTX (B) MXHTC
 (C) XMHCT (D) XMHTC

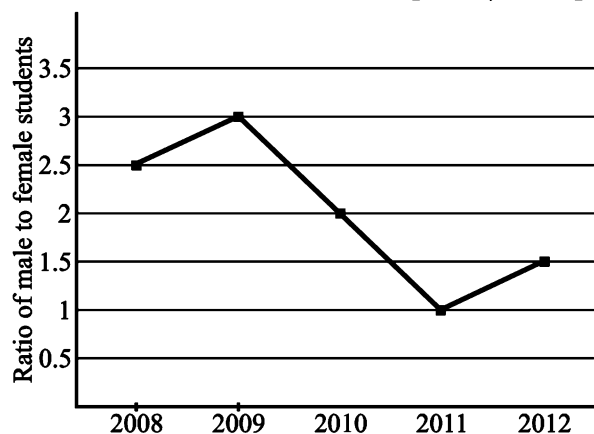
1.12 The statistics of runs scored in a series by four batsmen are provided in the following table. Who is the most consistent batsman of these four?

[EC-1, ME-1]

Batsman	Average	Standard deviation
<i>K</i>	31.2	5.21
<i>L</i>	46.0	6.35
<i>M</i>	54.4	6.22
<i>N</i>	17.9	5.90

- (A) *K* (B) *L*
 (C) *M* (D) *N*

1.13 The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students doubled in 2009, by what percent did the number of male students increase in 2009? [CS-2, EE-2]



1.14 In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is /are required to find the eldest child in the group?

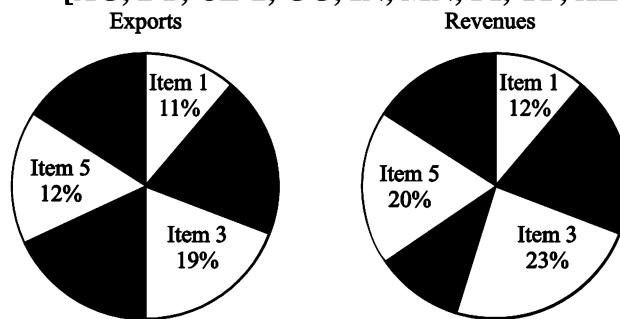
Statements :

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

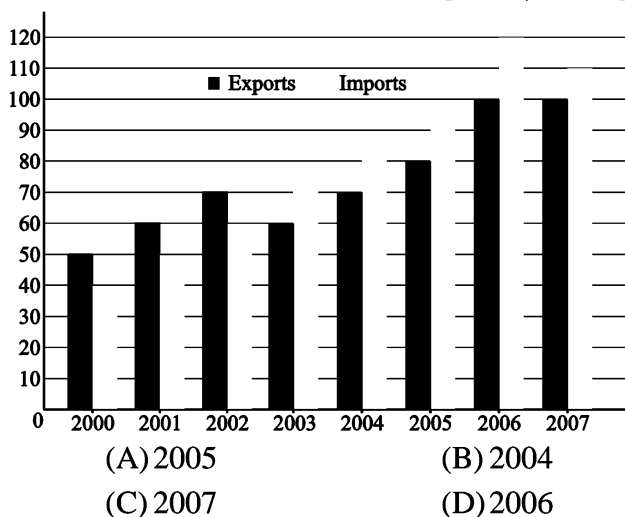
- Shiv is younger to Riaz.
 - Shiv is elder to Som.
- (A) Statement 1 by itself determines the eldest child.
 (B) Statement 2 by itself determines the eldest child.
 (C) Statements 1 and 2 are both required to determine the eldest child.
 (D) Statements 1 and 2 are not sufficient to determine the eldest child.

1.15 The total exports and revenues from the exports of a country are given in the pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tons and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of item 1 per kilogram to the revenue generated through export of the item 4 per kilogram?

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

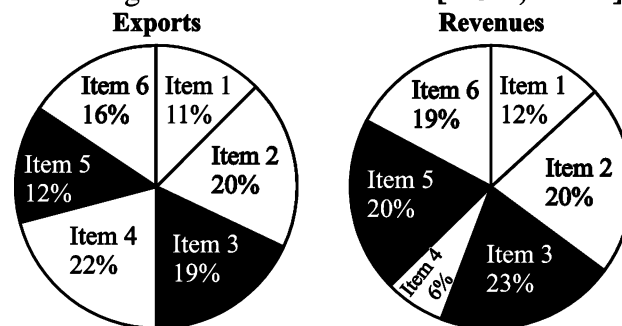


- (A) 1:2 (B) 2:1
(C) 1:4 (D) 4:1
- 1.16** For submitting tax returns, all resident males with annual income below Rs. 10 lakh should fill up form *P* and all resident females with income below Rs. 8 lakh should fill up form *Q*. All people with incomes above Rs. 10 lakh should fill up form *R*, except non-residents with income above Rs. 15 lakhs, who should fill up form *S*. All others should fill form *T*. An example of a person who should fill form *T* is, [EC-1, ME-1]
- (A) A resident male with annual income Rs. 9 lakh.
(B) A resident female with annual income Rs. 9 lakh.
(C) A non-resident male with annual income Rs. 16 lakh.
(D) A non-resident female with annual income Rs. 16 lakh.
- 1.17** The exports and imports (in crores of Rs.) of a country from 2000 to 2007 are given in the following bar chart. If the trade deficit is defined as excess of imports over exports, in which year is the trade deficit $\frac{1}{5}$ th of the exports? [EC-1, ME-1]



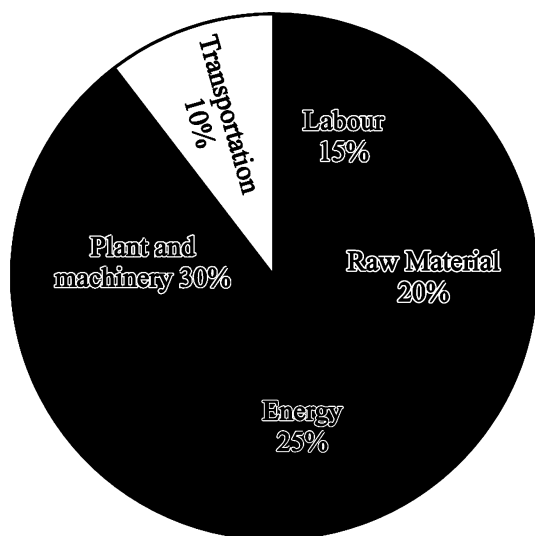
- 1.18** Lights of four colors (red, blue, green, yellow) are hung on a ladder. On every step of the ladder there are two lights. If one of the lights is red, the other light on that step will always be blue. If one of the lights on a step is green, the other light on that step will always be yellow. Which of the following statements is not necessarily correct? [EC-2, ME-2]
- (A) The number of red lights is equal to the number of blue lights.
(B) The number of green lights is equal to the number of yellow lights.
(C) The sum of the red and green lights is equal to the sum of the yellow and blue lights.
(D) The sum of the red and blue lights is equal to the sum of the green and yellow lights.

- 1.19** The total exports and revenues from the exports of a country are given in the two charts shown below. The pie chart for exports shows the quantity of each item exported as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 500 thousand tonnes and the total revenues are 250 crore rupees. Which item among the following has generated the maximum revenue per kg? [EC-2, ME-2]

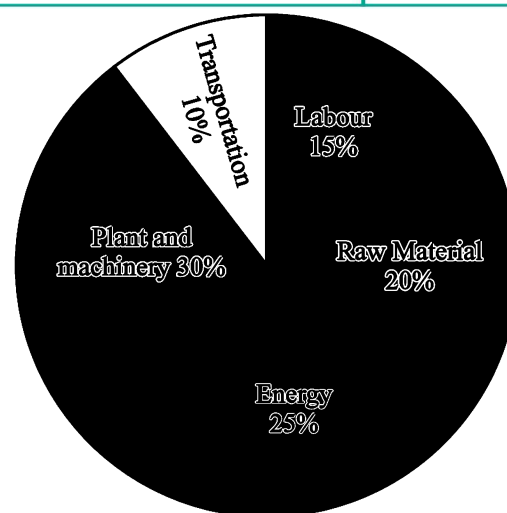


- (A) Item 2 (B) Item 3
(C) Item 6 (D) Item 5

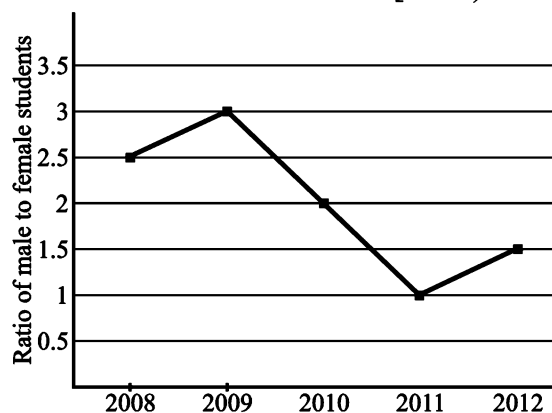
- 1.20** A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant and machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs. 4,50,000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. If the company registered profit of Rs. 10 lakhs in 2012, at what price in Rs. was each air purifier sold? [EC-3, ME-3]



- 1.21** A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy plant and machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs. 450000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. What is the percentage increase in total cost for the company in 2013? [EC-4, ME-4]



- 1.22** The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students in 2011 and 2012 is equal, what is the ratio of male students in 2012 to male students in 2011? [CS-3, EE-3]



- (A) 1 : 1 (B) 2 : 1
(C) 1.5 : 1 (D) 2.5 : 1

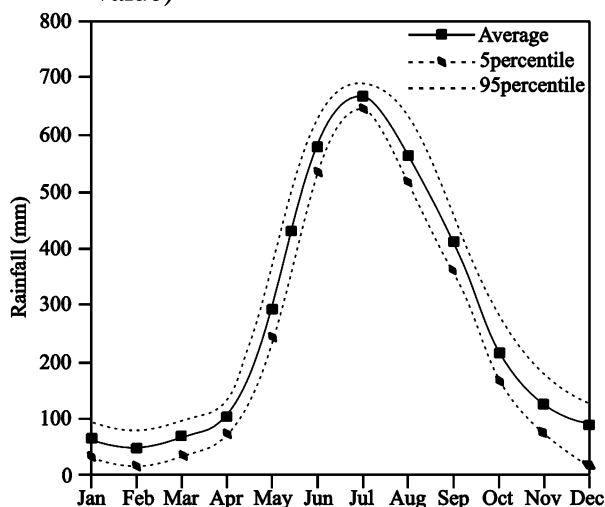
- 1.23** Anuj, Bhola, Chandan, Dilip, Eswar and Faisal live on different floors in a six-storeyed building (the ground floor is numbered 1, the floor above it 2, and so on). Anuj lives on an even-numbered floor. Bhola does not live on an odd numbered floor. Chandan does not live on any of the floors below Faisal's floor. Dilip does not live on floor number 2. Eswar does not live on a floor

immediately above or immediately below Bhola. Faisal lives three floors above Dilip. Which of the following floor-person, combinations is correct?

[AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

	Anuj	Bhola	Chandan	Dilip	Eswar	Faisal
(A)	6	2	5	1	3	4
(B)	2	6	5	1	3	4
(C)	4	2	6	3	1	5
(D)	2	4	6	1	3	5

- 1.24** The monthly rainfall chart based on 50 years of rainfall in Agra is shown in the following figure. Which of the following are true? (k percentile is the value such that k percent of the data fall below that value)



- On average, it rains more in July than in December
- Every year, the amount of rainfall in August is more than that in January
- July rainfall can be estimated with better confidence than February rainfall
- In August, there is at least 500 mm of rainfall

[AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

- (A) (i) and (ii) (B) (i) and (iii)
(C) (ii) and (iii) (D) (iii) and (iv)

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- 1.25** In the following question, the first and the last sentence of the passage are in order and numbered 1 and 6. The rest of the passage is split into 4 parts and numbered as 2, 3, 4 and 5. These 4 parts are not arranged in proper order. Read the sentences and arrange them in a logical sequence to make a passage and choose the correct sequence from the given options.

- On Diwali, the family rises early in the morning.
- The whole family, including the young and the old enjoy doing this.
- Children let off fireworks later in the night with their friends.
- At sunset, the lamps are lit and the family performs various rituals.
- Father, mother and children visit relatives and exchange gifts and sweets.
- Houses look so pretty with lighted lamps all around. [EC-3, ME-2]

- (A) 2, 5, 3, 4 (B) 5, 2, 4, 3
(C) 3, 5, 4, 2 (D) 4, 5, 2, 3

- 1.26** An electric bus has onboard instruments that report the total electricity consumed since the start of the trip as well as the total distance covered. During a single day of operation, the bus travels on stretches M , N , O and P , in that order. The cumulative distance travelled and the corresponding electricity consumption are shown in the Table below :

Stretch	Cumulative distance (km)	Electricity used (kWh)
M	20	12
N	45	25
O	75	45
P	100	57

The stretch where the electricity consumption per km is minimum is

[EC-2, ME-1]

- (A) *M* (B) *N*
(C) *O* (D) *P*

- 1.27 Ms. X will be in Bagdogra from 01/05/2014 to 20/05/2014 and from 22/05/2014 to 31/05/2014. On the morning of 21/05/2014, she will reach Kochi via Mumbai. Which one of the statements below is logically valid and can be inferred from the above sentences?

[EC-3, ME-2]

- (A) Ms. X will be in Kochi for one day, only in May.
(B) Ms. X will be in Kochi for only one day in May.
(C) Ms. X will be only in Kochi for one day in May.
(D) Only Ms. X will be in Kochi for one day in May.

- 1.28 Based on the given statements, select the most appropriate option to solve the given question.

If two floors in a certain building are 9 feet apart, how many steps are there in a set of stairs that extends from the first floor to the second floor of the building?

[CS-1, EE-1]

Statements :

- I. Each step is $\frac{3}{4}$ foot high.
II. Each step is 1 foot wide.
(A) Statement I alone is sufficient, but statement II alone is not sufficient.
(B) Statement II alone is sufficient, but statement I alone is not sufficient.
(C) Both statements together are sufficient, but neither statement alone is sufficient.
(D) Statement I and II together are not sufficient.

- 1.29 The given statement is followed by some courses of action. Assuming the statement to be true decide the correct option.

Statement :

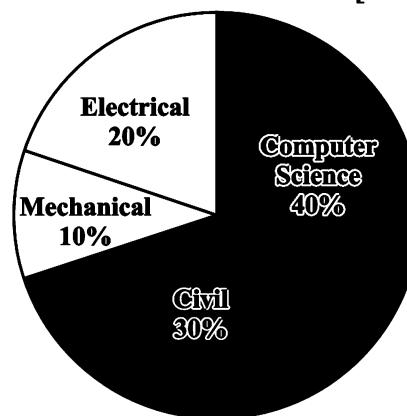
There has been a significant drop in the water level in the lakes supplying water to the city.

[CS-1, EE-1]

- I. The water supply authority should impose a partial cut in supply to tackle the situation.
II. The government should appeal to all the residents through mass media for minimal use of water.
III. The government should ban the water supply in lower areas.
(A) Statements I and II follow.
(B) Statements I and III follow.
(C) Statements II and III follow.
(D) All statements follow.

- 1.30 The pie chart below has the breakup of the number of students from different departments in an engineering college for the year 2012. The proportion of male to female students in each department is 5 : 4. There are 40 males in Electrical Engineering. What is the difference between the number of female students in the Civil department and the female students in the Mechanical department?

[CS-1, EE-1]



- 1.31** Based on the given statements, select the most appropriate option to solve the given question.

What will be the total weight of 10 poles each of same weight? [CS-2, EE-2]

Statements :

- I. One fourth of the weight of a pole is 5 kg.
 II. The total weight of these poles is 160 kg more than the total weight of two poles.

- (A) Statement I alone is not sufficient.
 (B) Statement II alone is not sufficient.
 (C) Either I or II alone is sufficient.
 (D) Both statement I and II together are not sufficient.

- 1.32** Four branches of a company are located at *M*, *N*, *O* and *P*. *M* is north of *N* at a distance of 4 km; *P* is south of *O* at a distance of 2 km; *N* is south-east of *O* by 1 km. What is the distance between *M* and *P* in km? [CS-2, EE-2]

- (A) 5.34 (B) 6.74
 (C) 28.5 (D) 45.49

- 1.33** Tanya is older than Eric. Cliff is older than Tanya. Eric is older than Cliff. If the first two statements are true, then the third statement is

[AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]

- (A) True (B) False
 (C) Uncertain
 (D) Data insufficient

- 1.34** If ROAD is written as URDG, then SWAN should be written as

[CE-1, CS-3]

- (A) VXDQ (B) VZDQ
 (C) VZDP (D) UXDQ

- 1.35** The head of a newly formed government desires to appoint five of the six selected members P, Q, R, S, T and U to portfolios

of Home, Power, Defense, telecom and Finance. U does not want any portfolio if S gets one of the five. R wants either Home or Finance or no portfolio. Q says that if S gets either Power or Telecom, then she must get the other one. T insists on a portfolio if P gets one.

Which is the valid distribution of portfolio? [CE-1, CS-3]

- (A) P-Home, Q-Power, R-Defense, S-Telecom, T-Finance
 (B) R- Home, S-Power, P-Defense, Q-Telecom, T-Finance
 (C) P- Home, Q-Power, T-Defense, S-Telecom, U-Finance
 (D) Q- Home, U-Power, T-Defense, R-Telecom, P-Finance

- 1.36** The given question is followed by two statements: select the most appropriate option that solves the question

Capacity of a solution tank A is 70% of the capacity of tank B. How many gallons of solution are in tank A and tank B? [CE-2]

Statement :

- I. Tank A is 80% full and tank B is 40% full
 II. Tank A if full contains 14,000 gallons of solution
 (A) Statement I alone is sufficient
 (B) Statement II alone is sufficient
 (C) Either statement I or II alone is sufficient
 (D) Both the statements I and II together are sufficient

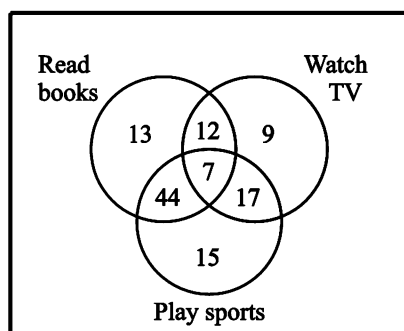
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- 1.37** In a huge pile of apples and oranges, both ripe and unripe mixed together, 15% are

unripe fruits. Of the unripe fruits, 45% are apples. Of the ripe ones, 66% are oranges. If the pile contains a total of 5692000 fruits, how many of them are apples? [EC-1, ME-1]

- (A) 2029198 (B) 2467482
(C) 2789080 (D) 3577422

- 1.38 The Venn diagram shows the preference of the student population for leisure activities.



From the data given, the number of students who like to read books or play sports is _____. [EC-2, ME-3]

- (A) 44 (B) 51
(C) 79 (D) 108

- 1.39 A flat is shared by four first year undergraduate students. They agreed to allow the oldest of them to enjoy some extra space in the flat. Manu is two month older than Sravan, who is three months younger than Trideep. Pavan is one month older than Sravan. Who should occupy the extra space in the flat?

[AR, CY, EC-3, IN, MA, PE]

- (A) Manu (B) Sravan
(C) Trideep (D) Pavan

- 1.40 M has a son Q and a daughter R. He has no other children. E is the mother of P and daughter-in-law of M. How is P related to M?

[AR, CY, EC-3, IN, MA, PE]

- (A) P is the son-in-law of M.
(B) P is the grandchild of M.

(C) P is the daughter-in law of M.

(D) P is the grandfather of M.

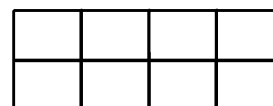
- 1.41 Among 150 faculty members in an institute, 55 are connected with each other through Facebook® and 85 are connected through WhatsApp®. 30 faculty members do not have Facebook® or WhatsApp® accounts. The number of faculty members connected only through Facebook® accounts is _____. [CS-2, EE-1]

- (A) 35 (B) 45
(C) 65 (D) 90

- 1.42 Pick the odd one from the following options. [CS-2, EE-1]

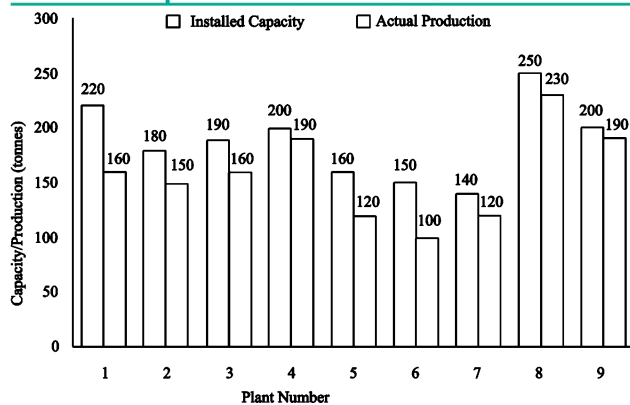
- (A) CADBE (B) JHKIL
(C) XWYZ (D) ONPMQ

- 1.43 In a 2×4 rectangle grid shown below, each cell is a rectangle. How many rectangles can be observed in the grid? [CS-2, EE-1]



- (A) 21 (B) 27
(C) 30 (D) 36

- 1.44 The following graph represents the installed capacity for cement production (in tonnes) and the actual production (in tonnes) of nine cement plants of a cement company. Capacity utilization of a plant is defined as ratio of actual production of cement to installed capacity. A plant with installed capacity of at least 200 tonnes is called a large plant and a plant with lesser capacity is called a small plant. The difference between total production of large plants and small plants, in tonnes is _____. [AE, EE-2, TF, XE, XL]



- 1.45 If 'relftaga' means carefree, 'otaga' means careful and 'fertaga' means careless, which of the following could mean 'aftercare'? [CE-1, CS-1]

(A) Zentaga (B) Tagafer
(C) Tagazen (D) Relffer

- 1.46 A shaving set company sells 4 different types of razors, Elegance, Smooth, Soft and Executive. Elegance sells at Rs. 48, Smooth at Rs. 63, Soft at Rs. 78 and Executive at Rs. 173 per piece. The table below shows the numbers of each razor sold in each quarter of a year.

Quarter/ Product	Elegance	Smooth	Soft	Executive
Q1	27300	20009	17602	9999
Q2	25222	19392	18445	8942
Q3	28976	22429	19544	10234
Q4	21012	18229	16595	10109

Which product contributes the greatest fraction to the revenue of the company in that year? [CE-1, CS-1]

- (A) Elegance (B) Executive
(C) Smooth (D) Soft
- 1.47 Consider the following statements relating of the level of poker play of four players P , Q , R and S .
- P always beats Q
 - R always beats S
 - S loses to P only sometimes
 - R always loses to Q
- Which of the following can be logically inferred from the above statements?

(i) P is likely to beat all the three other players

(ii) S is the absolute worst player in the set [CE-1, CS-1]

- (A) (i) only (B) (ii) only
(C) (i) and (ii)
(D) neither (i) nor (ii)

- 1.48 Find the missing sequence in the letter series. [BT, CH, GG, ME-2, MN, PH] B, FH, LNP, _____.

(A) SUWY (B) TUVW
(C) TVXZ (D) TWXZ

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- 1.49 S , T , U , V , W , X , Y and Z are seated around a circular table. T 's neighbors are Y and V . Z is seated third to the left of T and second to the right of S . U 's neighbors are S and Y ; and T and W are not seated opposite each other. Who is third to the left of V ?

[BT, CY, EC-1, EY, PI]

(A) X (B) W
(C) U (D) T

- 1.50 Each of P , Q , R , S , W , X , Y and Z has been married at most once. X and Y married and have two children P and Q , Z is grandfather of the daughter ' S ' of P . Further Z and W married and are parents of R . Which one of the following must necessarily be FALSE?

[AE, EC-2, MA, MT, PE, PH]

(A) X is the mother-in-law to R
(B) P and R are not married to each other
(C) P is son of X and Y
(D) Q cannot be married to R

- 1.51 Rahul, Murali, Srinivas and Arul are seated around a square table. Rahul is sitting to the left of Murali, Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other? [CS-1, EE-1]

- (A) Rahul and Murali
 (B) Srinivas and Arul
 (C) Srinivas and Murali
 (D) Srinivas and Rahul

1.52 There are three boxes. One contains apples, another contains oranges and the last one contains both apples and oranges. All three are known to be incorrectly labelled. If you are permitted to open just one box and then pull out and inspect only one fruit, which box would you open to determine the contents of all three boxes? [CS-2, EE-2]

- (A) The box labelled 'Apples'
 (B) The box labelled 'Apples and Oranges'
 (C) The box labelled 'Oranges'
 (D) Cannot be determined

1.53 Four cards lie on a table. Each card has a number printed on one side and a colour on the other. The faces visible on the cards are 2, 3, red and blue.

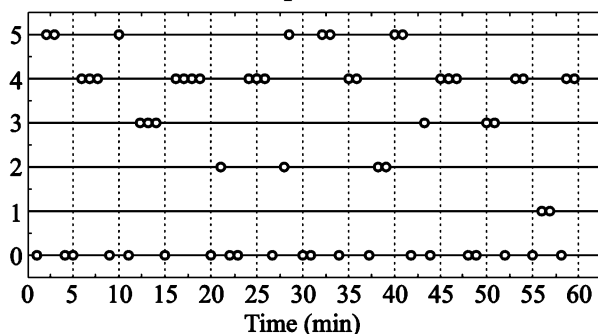
Proposition : If a card has an even value on one side, then its opposite face is red.

[CE-2, IN, XE, XL]

The cards which must be turned over to verify the above proposition are

- (A) 2, red (B) 2, 3, red
 (C) 2, blue (D) 2, red, blue

1.54 The points in the graph below represent the halts of a lift for durations of 1 minute, over a period of 1 hour.



Which of the following statements are correct? [CE-2, IN, XE, XL]

- (i) The elevator never moves directly from any non-ground floor to another non-ground floor over the one hour period.
 (ii) The elevator stays on the fourth floor for the longest duration over the one hour period.

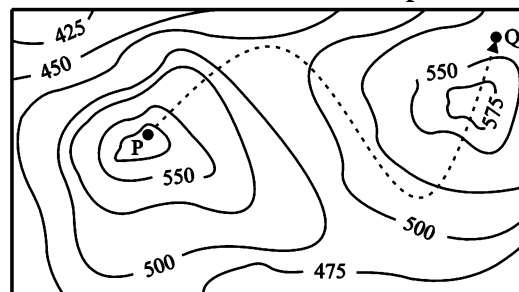
- (A) Only (i)
 (B) Only (ii)
 (C) Both (i) and (ii)
 (D) Neither (i) nor (ii)

1.55 40% of deaths on city roads may be attributed to drunken driving. The number of degrees needed to represent this as a slice of a pie chart is

[BT, CY, EC-1, EY, PI]

- (A) 120 (B) 144
 (C) 160 (D) 212

1.56 A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot.



The path from *P* to *Q* is best described by, [BT, CY, EC-1, EY, PI]

- (A) Up-Down-Up-Down
 (B) Down-Up-Down-Up
 (C) Down-Up-Down
 (D) Up-Down-Up

1.57 500 students are taking one or more courses out of Chemistry, Physics and Mathematics. Registration records

indicate course enrolment as follows : Chemistry (329), Physics (186), Mathematics (295), Chemistry and Physics (83), Chemistry and Mathematics (217), and Physics and Mathematics (63). How many students are taking all 3 subjects?

[AE, EC-2, MA, MT, PE, PH]

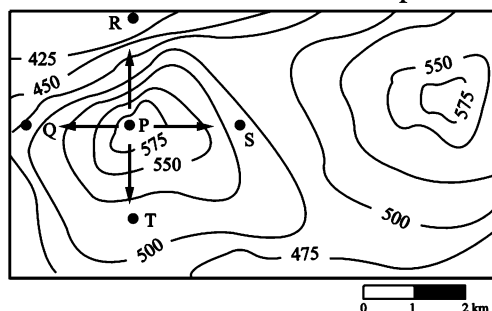
- (A) 37 (B) 43
(C) 47 (D) 53

- 1.58 A rule states that in order to drink beer, one must be over 18 years old. In a bar, there are 4 people P is 16 years old, Q is 25 years old, R is drinking milkshake and S is drinking a beer. What must be checked to ensure that the rule is being followed?

[AE, EC-2, MA, MT, PE, PH]

- (A) Only P 's drink
(B) Only P 's drink and S 's age
(C) Only S 's age
(D) Only P 's drink, Q 's drink and S 's age

- 1.59 A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot.

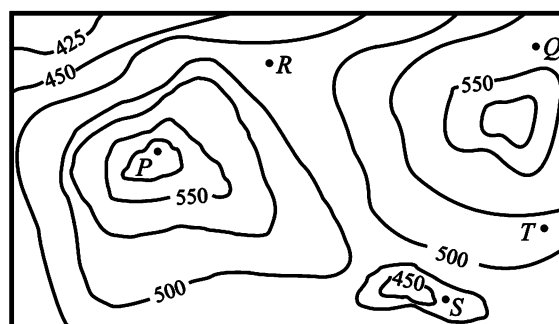


Which of the following is the steepest path leaving from P ?

[AE, EC-2, MA, MT, PE, PH]

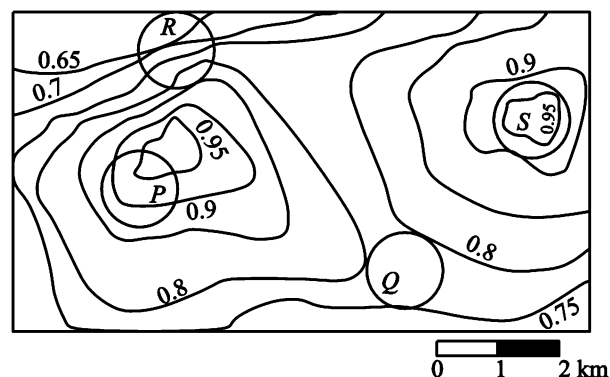
- (A) P to Q (B) P to R
(C) P to S (D) P to T

- 1.60 A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot. If in a flood the water level rises to 525 m, which of the villages P , Q , R , S , T gets submerged? [CS-1, EE-1]



- (A) P , Q (B) P , Q , T
(C) R , S , T (D) Q , R , S

- 1.61 An air pressure contour line joins locations in a region having the same atmospheric pressure. The following is an air pressure contour plot of a geographical region. Contour lines are shown at 0.05 bar intervals in this plot.



If the possibility of a thunderstorm is given by how fast air pressure rises or drops over a region, which of the following regions is most likely to have a thunderstorm? [CS-2, EE-2]

- (A) P (B) Q
(C) R (D) S

- 1.62** P, Q, R, S, T and U are seated around a circular table. R is seated two places to the right of Q . P is seated three places to the left of R . S is seated opposite U . If P and U now switch seats, which of the following must necessarily be true?

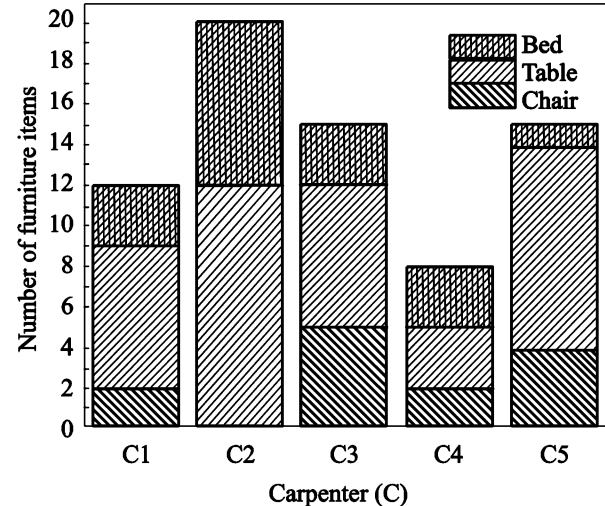
[CE-2, IN, XE, XL]

- (A) P is immediately to the right of R .
 (B) T is immediately to the left of P .
 (C) T is immediately to the left of P or P is immediately to the right of Q .
 (D) U is immediately to the right of R or P is immediately to the left of T .
- 1.63** Students applying for hostel rooms are allotted rooms in order of seniority. Students already staying in a room will move if they get a room in their preferred list. Preferences of lower ranked applicants are ignored during allocation.

Given the data below, which room will Ajit stay in [CE-1, CH, MN]

Names	Student seniority	Current room	Room preference list
Amar	1	P	R, S, Q
Akbar	2	None	R, S
Anthony	3	Q	P
Ajit	4	S	Q, P, R

- (A) P (B) Q
 (C) R (D) S
- 1.64** The bar graph below shows the output of five carpenters over one month, each of whom made different items of furniture : chairs, table, and beds.



Consider the following statements :

- (i) The number of beds made by carpenter C2 is exactly the same as the number of tables made by carpenter C3.
 (ii) The total number of chairs made by all carpenters is less than total number of tables.

Which one of the following is true?

[CE-1, CH, MN]

- (A) Only i
 (B) Only ii
 (C) Both i and ii
 (D) Neither i nor ii

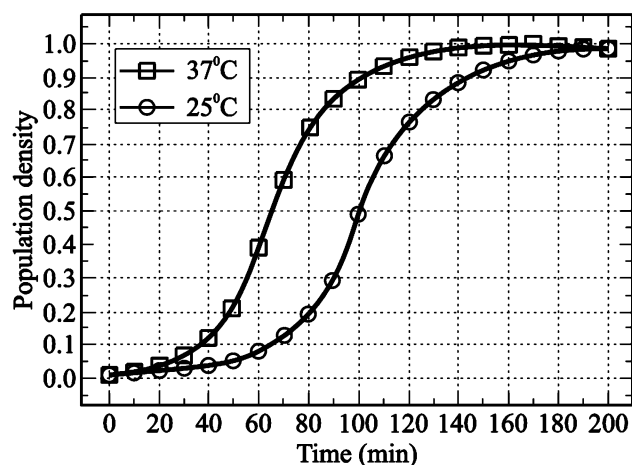
- 1.65** P, Q , and R talk about S 's car collection. P states that S has at least 3 cars. Q believes that S has less than 3 cars. R indicates that to his knowledge, S has at least one car. Only one of P, Q and R is right. The number of cars owned by S is

[AR, ME-1, TF]

- (A) 0
 (B) 1
 (C) 3
 (D) Cannot be determined

- 1.66** The growth of bacteria (*Lactobacillus*) in milk leads to curd formation. A minimum bacterial population density of 0.8 (in

suitable units) is needed to form curd. In the graph below, the population density of lactobacillus in 1 litre of milk is plotted as a function of time, at two different temperatures, 25°C and 37°C .



Consider the following statements based on the data shown above :

- (i) The growth in bacterial population stops earlier at 37°C as compared to 25°C
- (ii) The time taken for curd formation at 25°C is twice the time taken at 37°C

Which one of the following options is correct? [AR, ME-1, TF]

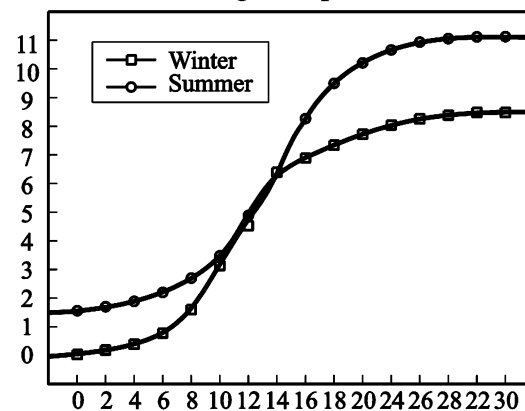
- (A) Only (i)
- (B) Only (ii)
- (C) Both (i) and (ii)
- (D) Neither (i) nor (ii)

- 1.67 P looks at Q while Q looks at R . P is married R is not. The number of pairs of people in which a married person is looking at an unmarried person is

[AG, GG, ME-2]

- (A) 0
- (B) 1
- (C) 2
- (D) Can not be determined

- 1.68 In the graph below, the concentration of a particular pollutant in a lake is plotted over (alternate) days of a month in winter (average temperature 10°C) and a month in summer (average temperature 30°C)



Consider the following statements based on the data shown above :

- (i) Over the given months, the difference between the maximum and the minimum pollutant concentrations is the same in both winter and summer.
- (ii) There are at least four days in the summer month such that the pollutant concentration on those days are within 1 ppm of the pollutant concentrations on the corresponding days in the winter month.

Which one of the following option is correct? [AG, GG, ME-2]

- (A) Only (i)
- (B) Only (ii)
- (C) Both (i) and (ii)
- (D) Neither (i) nor (ii)

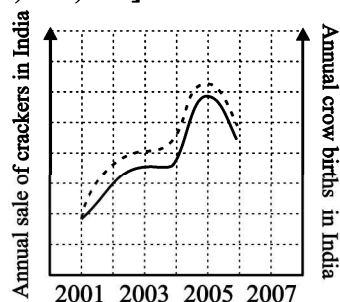
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- 1.69 In a certain code, $AMCF$ is written as $EQGJ$ and $NKUF$ is written as $ROYJ$. How will $DHLP$ be written in that code?

[EE]

- (A) *RSTN* (B) *TLPH*
(C) *HLPT* (D) *XSVR*
- 1.70** *P*, *Q*, *R* and *S* crossed a lake in a boat that can hold a maximum of two persons, with only one set of oars. The following additional facts are available.
- The boat held two persons on each of the three forward trips across the lake and one person on each of the two return trips.
 - P* is unable to row when someone else is in the boat.
 - Q* is unable to row with anyone else except *R*.
 - Each person rowed for at least one trip
 - Only one person can row during a trip
- Who rowed twice? [EE]
- (A) *P* (B) *Q*
(C) *R* (D) *S*

- 1.71** In a detailed study of annual crow births in India, it was found that there was relatively no growth during the period 2002 to 2004 and a sudden spike from 2004 to 2005. In another unrelated study, it was found that the revenue from cracker sales in India which remained fairly flat from 2002 to 2004, saw a sudden spike in 2005 before declining again in 2006. The solid line in the graph below refers to annual sale of crackers and the dashed line refers to the annual crow births in India. Choose the most appropriate inference from the above data. [AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]



- (A) There is a strong correlation between crow birth and cracker sales.
(B) Cracker usage increases crow birth rate.
(C) If cracker sale declines, crow birth will decline.
(D) Increased birth rate of crows will cause an increase in the sale of crackers

- 1.72** To pass a test, a candidate needs to answer at least 2 out of 3 questions correctly. A total of 6,30,000 candidates appeared for the test. Question *A* was correctly answered by 3,30,000 candidates. Question *B* was answered correctly by 2,50,000 candidates, Question *C* was answered correctly by 2,60,000 candidates. Both questions *A* and *B* were answered correctly by 1,00,000 candidates. Both questions *B* and *C* were answered correctly by 90,000 candidates. Both questions *A* and *C* were answered correctly by 80,000 candidates. If the number of students answering all questions correctly is the same as the number answering none, how many candidates failed to clear the test?

[AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]

- (A) 30,000 (B) 2,70,000
(C) 3,90,000 (D) 4,20,000

- 1.73** The temperature T in a room varies as a function of the outside temperature T_0 and the number of persons in the room p , according to the relation $T = K(\theta p + T_0)$, where θ and K are constants. What would be the value of θ , which gives the following data? [CE-1]

T_0	p	T
25	2	32.4
30	5	42.0

- (A) 0.8 (B) 1.0
(C) 2.0 (D) 10.0

- 1.74** Each of the letters arranged as below represents a unique integer from 1 to 9. The letters are positioned in the figure such that $(A \times B \times C)$, $(B \times G \times E)$ and $(D \times E \times F)$ are equal. Which integer among the following choices cannot be represented by the letters A, B, C, D, E, F and G? [CE-1]

A		D
B	G	E
C		F

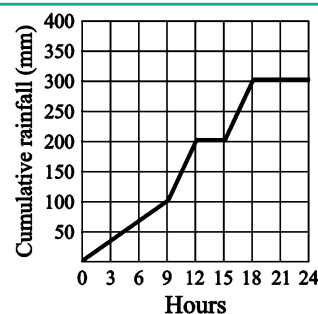
- (A) 4 (B) 5
(C) 6 (D) 9

- 1.75** Each of the letters in the figure below represents a unique integer from 1 to 9. The letters are positioned in the figure such that each of $(A+B+C)$, $(C+D+E)$, $(E+F+G)$ and $(G+H+K)$ is equal to 13. Which integers does E represent? [CE-2]

A	B	C		
		D		
	E	F	G	
		H		
		K		

- (A) 1 (B) 4
(C) 6 (D) 7

- 1.76** The annual average rainfall in a tropical city is 1000 mm. On a particular rainy day (24-hour period), the cumulative rainfall experienced by the city is shown in the graph. Over the 24-hour period, 50% of the rainfall falling on a rooftop, which had an obstruction-free area of 50 m^2 was harvested into a tank. What is the total volume of water collected in the tank in liters? [CE-2]



- (A) 25,000 (B) 18,750
(C) 7500 (D) 3125

- 1.77** A house has a number which needs to be identified. The following three statements are given that can help in identifying the house number.

- (i) If the house number is a multiple of 3, then it is a number from 50 to 59.
(ii) If the house number NOT a multiple of 4, then it is a number from 60 to 69.
(iii) If the house number is NOT a multiple of 6, then it is a number from 70 to 79.

What is the house number?

[AE, MA, ME-2, PI]

- (A) 54 (B) 65
(C) 66 (D) 76

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- 1.78** If $E = 10$; $J = 20$; $O = 30$; $T = 40$, what will be $P + E + S + T$? [CE-1]

- (A) 51 (B) 120
(C) 82 (D) 164

- 1.79** P, Q, R, S and T are related and belong to the same family. P is the brother of S. Q is the wife of P, R and T are the children of the siblings P and S respectively. Which one of the following statements is necessarily FALSE? [CE-1]

- (A) S is the sister-in-law of Q
(B) S is the aunt of R
(C) S is the brother of P
(D) S is the aunt of T

- 1.80** Mohan, the manager, wants his four workers to work in pairs. No pairs should work for more than 5 hours. Ram and John have worked together for 5 hours. Krishna and Amir have worked as a team for 2 hours. Krishna does not want to work with Ram. Whom should Mohan allot to work with John, if he wants all the workers to continue working? [CE-2]

(A) Amir
(B) Krishna
(C) Ram
(D) None of the three

- 1.81** The police arrested four criminals – *P*, *Q*, *R* and *S*. The criminals knew each other. They made the following statements :

P says “*Q* committed the crime”

Q says “*S* committed the crime”

R says “I did not do it”

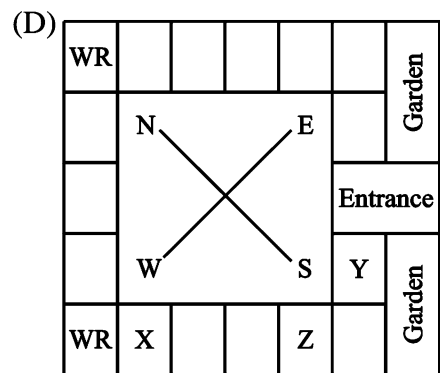
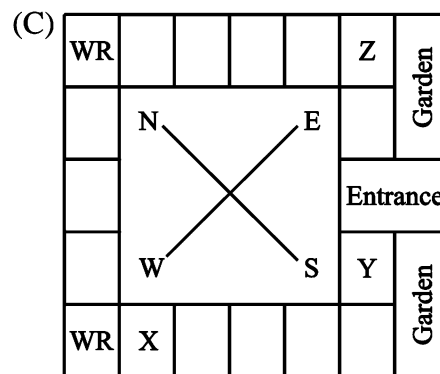
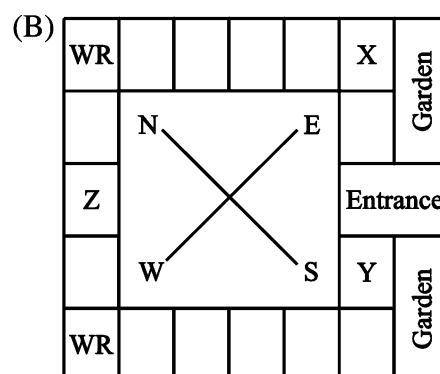
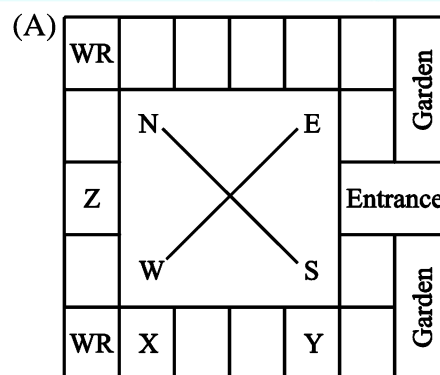
S says “What *Q* said about me is false”

Assume only one of the arrested four committed the crime and only one of the statements made above is true. Who committed the crime? [CH, CS]

(A) *P* (B) *R*
(C) *S* (D) *Q*

- 1.82** Three of the five students allocated to a hostel put in special requests to the warden. Given the floor plan of the vacant rooms, select the allocation plan that will accommodate all their requests.
- Request by X: Due to pollen allergy, I want to avoid a wing next to the garden.
- Request by Y : I want to live as far from the washrooms as possible, since I am very sensitive to smell.
- Request by Z: I believe in Vaastu and so want to stay in the South – west wing.

[CH, CS]



- 1.83** Four people are standing in a line facing you. They are Rahul, Mathew, Seema and Lohit. One is engineer, one is a doctor, one a teacher and another a dancer. You are told that :

1. Mathew is not standing next to Seema.
2. There are two people standing between Lohit and the engineer.
3. Rahul is not a doctor.
4. The teacher and the dancer are standing next to each other.
5. Seema is turning to her right to speak to the doctor standing next to her.

Who among them is an Engineer? [EC]

- (A) Lohit (B) Seema
(C) Rahul (D) Mathew

- 1.84** Five people P, Q, R, S and T work in a bank. P and Q don't like each other but have to share an office till T gets a promotion and moves to the big office next to the garden. R, who is currently sharing an office with T, wants to move to the adjacent office with S, the handsome new intern.

Given the floor plan, what is the current location of Q, R and T ? [O = office, WR = Wash room] [EC]

(A)

WR	01 P,Q	02	03 R,T	04 S
Manager	Entry	Teller 1	Teller 2	
Garden				

(B)

WR	01 P,Q	02	03 R	04 S
Manager T	Entry	Teller 1	Teller 2	
Garden				

(C)

WR	01 P,Q	02	03 T	04 R,S
Manager	Entry	Teller 1	Teller 2	
Garden				

(D)

WR	01 P	02 Q	03 R	04 S
Manager T	Entry	Teller 1	Teller 2	
Garden				

- 1.85** Consider five people – Mita, Ganga, Rekha, Lakshmi and Sana. Ganga is taller than both Rekha and Lakshmi. Lakshmi is taller than Sana. Mita is taller than Ganga.

Which of the following conclusions are true? [EE]

1. Lakshmi is taller than Rekha
2. Rekha is shorter than Mita
3. Rekha is taller than Sana
4. Sana is shorter than Ganga

- (A) 2 and 4 (B) 1 only
(C) 1 and 3 (D) 3 only

- 1.86** If IMHO = JNIP, IDK = JEL and SO = TP then IDC = _____.

[ME-2, TF, XE, XL]

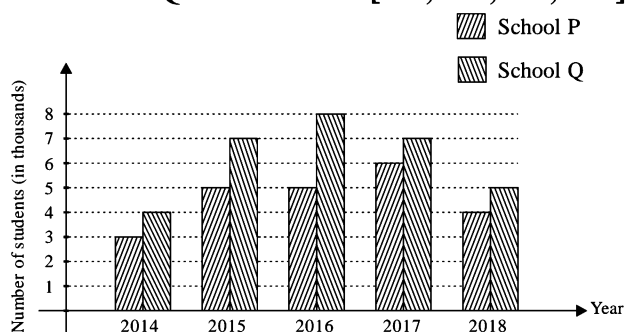
- (A) JDE (B) JED
(C) JCE (D) JEC

- 1.87** M and N had four children (P, Q, R and S) of them, only P and R are married. They had children X and Y respectively. If Y is the legitimate child of W, which one of the following statement is necessarily FALSE? [CY, ME-1, MN]

- (A) W is the wife of P
 (B) W is the wife of R
 (C) M is the grandmother of Y
 (D) R is the father of Y

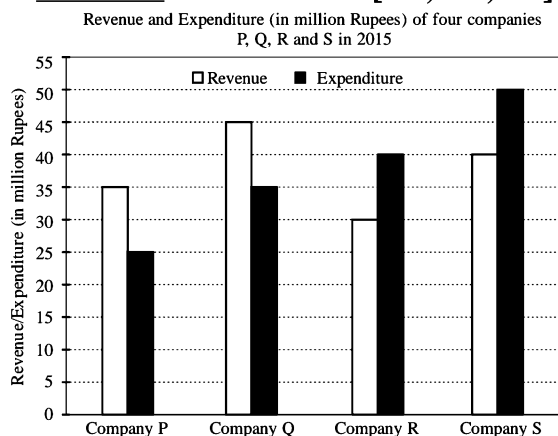
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- 1.88** The following figure shows the data of students enrolled in 5 years (2014 to 2018) for two schools P and Q. During this period, the ratio of the average number of the students enrolled in school P to the average of the difference of the number of students enrolled in schools P and Q is [AE, AG, EC, GG]



- (A) 31 : 23 (B) 23 : 8
 (C) 23 : 31 (D) 8 : 23

- 1.89** The revenue and expenditure of four different companies P, Q, R and S in 2015 are shown in the figure. If the revenue of company Q in 2015 was 20% more than that in 2014 and company Q had earned a profit of 10% on expenditure in 2014, then its expenditure (in million rupees) in 2014 was [EE, EY, TF]



- (A) 34.1 (B) 35.1
 (C) 33.7 (D) 32.7

- 1.90** Select the next element of the series : Z, WV, RQP, _____ [EE, EY, TF]

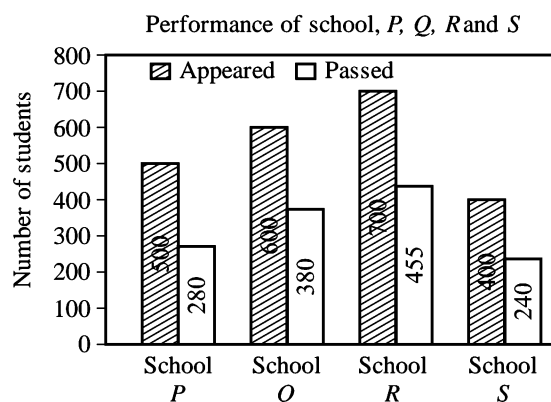
- (A) LKJI (B) KJIH
 (C) NMLK (D) JIHG

- 1.91** P, Q, R and S are to be uniquely coded using α and β . If P is coded as $\alpha\alpha$ and Q as $\alpha\beta$, then R and S respectively, can be coded as _____.

[IN, ME-1, MT, PE, PH]

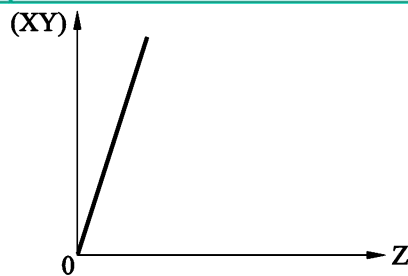
- (A) $\beta\alpha$ and $\beta\beta$ (B) $\alpha\beta$ and $\beta\beta$
 (C) $\beta\beta$ and $\alpha\alpha$ (D) $\beta\alpha$ and $\alpha\beta$

- 1.92** The bar graph shows the data of students who appeared and passed in an examination for four schools P, Q, R and S. The average of success rate (in percentage) of these four schools is [IN, ME-1, MT, PE, PH]



- (A) 59.3 % (B) 58.8 %
 (C) 59.0 % (D) 58.5 %

- 1.93** An Engineer measures THREE quantities X, Y and Z in an experiment. She finds that they follow a relationship that is represented in the figure below : (the product of X and Y linearly varies with Z).

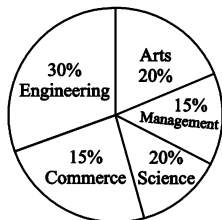


Then, which of the following statements is FALSE? [CY, ME-2, PI]

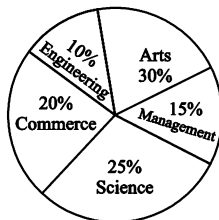
- (A) For fixed Y; X is proportional to Z
 (B) For fixed Z; X is proportional to Y
 (C) XY/Z is constant
 (D) For fixed X; Z is proportional to Y

- 1.94** The two pie-charts given below. Show the data of total students and only girls registered in different streams in a university. If the total number of students registered in the university students is 5000, and the total number of the registered girls is 1500; then the ratio of boys enrolled in Arts to the girls enrolled in the Management is ____.

Percentage of students enrolled in different streams in a University

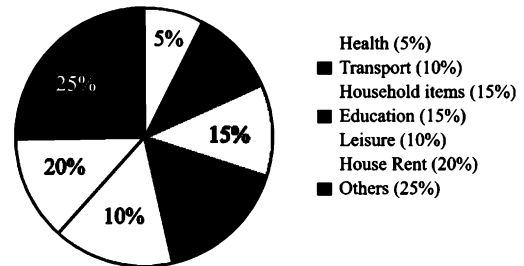


Percentage of girls enrolled in different streams



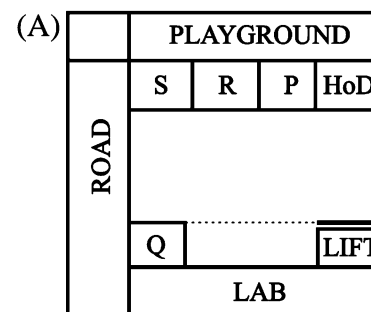
- (A) 2 : 1
 (B) 9 : 22
 (C) 11 : 9
 (D) 22 : 9
- 1.95** If 0, 1, 2, ..., 7, 8, 9 are coded as O, P, Q, ..., V, W, X, then 45 will be coded as _____. [CE-1]
- (A) SU
 (B) ST
 (C) SS
 (D) TS
- 1.96** The total expenditure of a family, on different activities in a month, is shown in the pie-chart. The extra money spent

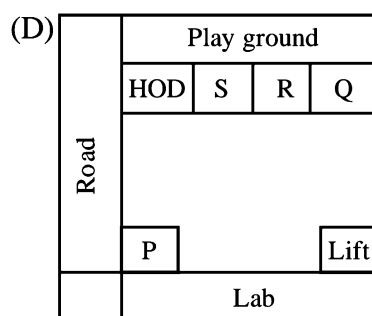
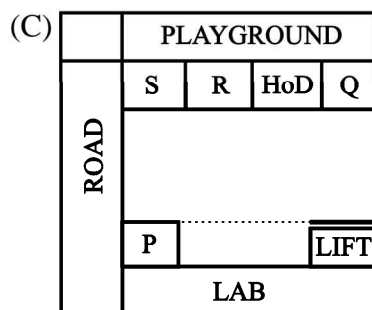
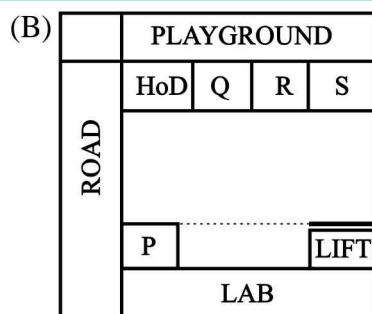
on education as compared to transport (in percent) is _____. [CE-1]



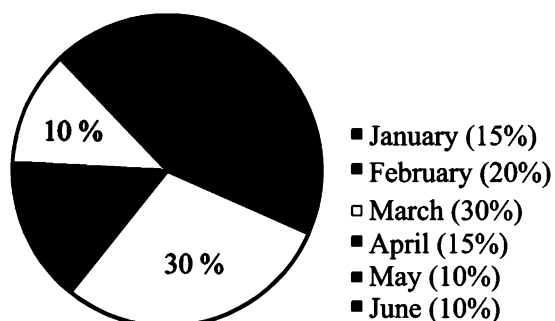
- (A) 100
 (B) 50
 (C) 33.3
 (D) 5
- 1.97** Five friends P, Q, R, S and T went camping. At night, they had to sleep in a row inside the tent. P, Q, and T refused to sleep next to R since he snored loudly. P and S wanted to avoid Q as he usually hugged people in sleep.
- Assuming everyone was satisfied with the sleeping arrangements, what is the order in which they slept? [CE-1]
- (A) RSPTQ
 (B) QRSPT
 (C) QTSPR
 (D) SPRTQ
- 1.98** After the inauguration of the new building, the Head of the Department (HoD) collated faculty preferences for office space. P wanted a room adjacent to the lab. Q wanted to be close to the lift. R wanted a view of the playground and S wanted a corner office.

Assuming that everyone was satisfied, which among the following shows a possible allocation? [CE-2]





- 1.99 The monthly distribution of 9 Watt LED bulbs sold by two firms X and Y from January to June 2018 is shown in the pie-chart and the corresponding table. If the total number of LED bulbs sold by two firms during April-June 2018 is 50000, then the number of LED bulbs sold by the firm Y during April-June 2018 is _____.
- [CE-2]



Month	Ratio of LED bulbs sold by two firms (X:Y)
January	7:8
February	2:3
March	2:1
April	3:2
May	1:4
June	9:11

- (A) 8250 (B) 9750
(C) 8750 (D) 11250

- 1.100 Nominal interest rate is defined as the amount paid by the borrower to the lender for using the borrowed amount for a specific period of time. Real interest rate calculated on the basis of actual value (inflation-adjusted), is approximately equal to the difference between nominal rate and expected rate of inflation in the economy. Which of the following assertions is best supported by the above information?

[CE-2]

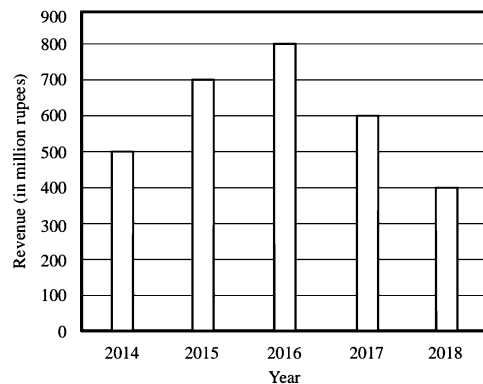
- (A) Under high inflation, real interest rate is low and borrowers get benefited.
 (B) Under low inflation, real interest rate is low and borrowers get benefited.
 (C) Under low inflation, real interest rate is low and borrowers get benefited.
 (D) Under high inflation, real interest rate is low and lenders get benefited.

- 1.101 If $P = 3$, $R = 27$, $T = 243$, then $Q + S =$ _____.
- [CS]

- (A) 40 (B) 110
(C) 90 (D) 80

- 1.102 The total revenue of a company during 2014-2018 is shown in the bar graph. If the total expenditure of the company in each year is 500 million rupees, then the aggregated profit or loss (in percentage)

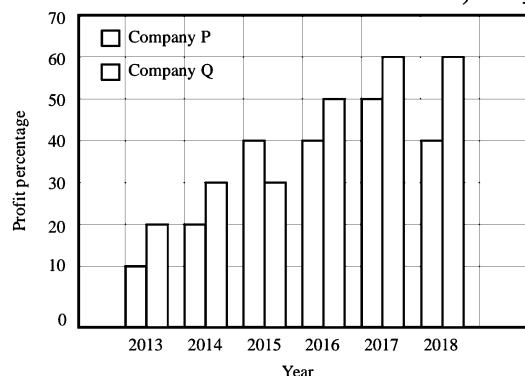
on the total expenditure of the company during 2014-2018 is _____. [CS]



- (A) 20% profit (B) 20% loss
(C) 16.67 % loss (D) 16.67% profit

- 1.103** The profit shares of two companies P and Q are shown in the figure. If the two companies have invested a fixed and equal amount every year, then the ratio of the total revenue of company P to the total revenue of company Q, during 2013 – 2018 is _____.

[AR, BM, BT, CH, MA, MN, ST, XE, XL]



- (A) 15 : 17 (B) 16 : 17
(C) 17 : 15 (D) 17 : 16

- 1.104** P, Q, R, S, T, U, V and W are seated around a circular table.

- (i) S is seated opposite to W.
(ii) U is seated at the second place to the right of R.
(iii) T is seated at the third place to the left of R.
(iv) V is a neighbor of S.

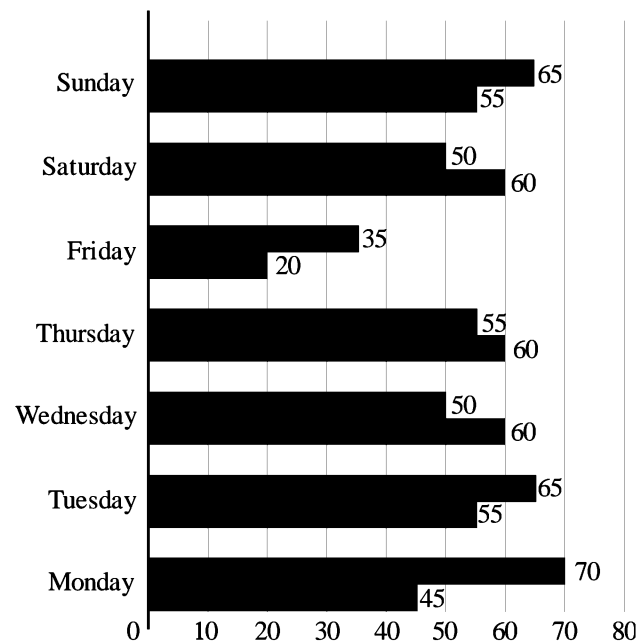
Which of the following must be true?

[AR, BM, BT, CH, MA, MN, ST, XE, XL]

- (A) P is not seated opposite to Q
(B) R is the left neighbor of S
(C) Q is a neighbor of R
(D) P is a neighbor of R

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1.105



■ Y ■ X

The number of minutes spent by two Students, X and Y, exercising every day in a given week are shown in the bar chart above.

The number of days in a given week in which one of the students spent a minimum of 10% more than the other student, on a given day, is

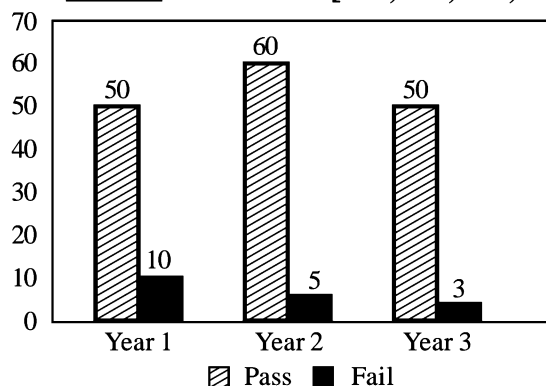
[EC, ES, PE, PI, ST]

- (A) 5 (B) 4
(C) 7 (D) 6

- 1.106** The number of student passing or failing in an exam for a particular subject are presented in the bar chart above. Students who pass the exam cannot appear for the

exam again. Students who fail the exam in the first attempt must appear for the exam in the following year. Students always pass the exam in their second attempt. The number of students who took the exam for the first time in the year 2nd and the year 3rd respectively, are _____.

[AG, EE, EY, GG]



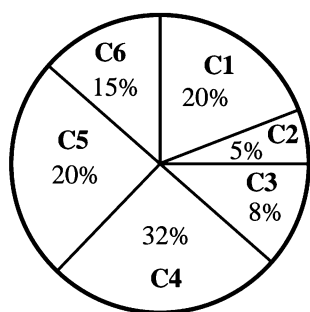
(A) 65 and 53

(B) 55 and 53

(C) 55 and 48

(D) 60 and 50

1.107



Company	Ratio
C1	3 : 2
C2	1 : 4
C3	5 : 3
C4	2 : 3
C5	9 : 1
C6	3 : 4

The distribution of employees at the rank of executives, across different companies C1, C2, ..., C6 is presented in the chart given above. The ratio of executives with a management degree to those without a management degree in each of these companies is provided in the table above. The total number of executives across all companies is 10,000.

The total number of management degree holders among the executives in companies C2 and C5 together is _____.

[ME-1, XH]

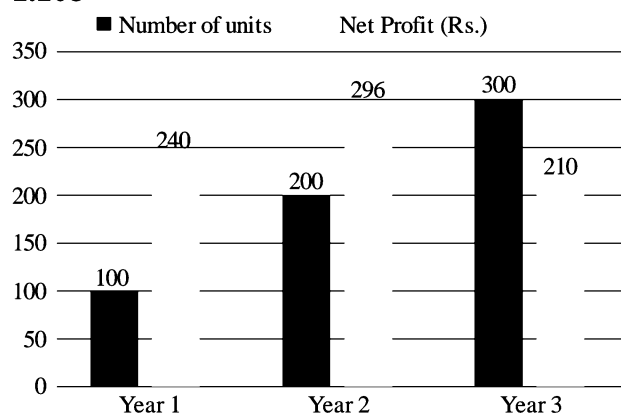
(A) 2500

(B) 600

(C) 1900

(D) 225

1.108



The number of units of a product sold in three different years and the respective net profits are presented in the figure above. The cost/unit in Year 3 was Rs.1, which was half the cost/unit in Year 2. The cost/unit in Year 3 was one-third of the cost/unit in Year 1. Taxes were paid on the selling price at 10%, 13% and 15% respectively for the three years. Net profit is calculated as the difference between the selling price and the sum of cost and taxes paid in that year. The ratio of the selling price in Year 2 to the selling price in Year 3 is _____

[CS-2, XE, XL]

(A) 3 : 4

(B) 1 : 1

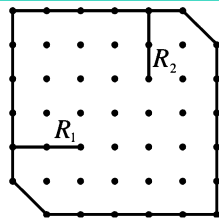
(C) 1 : 2

(D) 4 : 3

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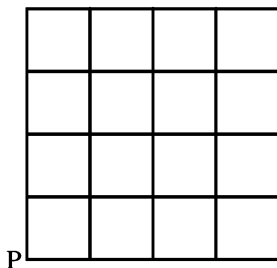
1.109 A plot of land must be divided between four families. They instant their individual plots to be similar in shape, not necessarily in area. The land has equally spaced placed marked as dots on the below figure. Two ropes R_1 and R_2 are already present and cannot be moved. What is the least number of additional straight ropes needed to needs to divided plot? A straight rope can pass through three poles that are aligned in a straight line

[CSE]



- (A) 2 (B) 3
(C) 4 (D) 5

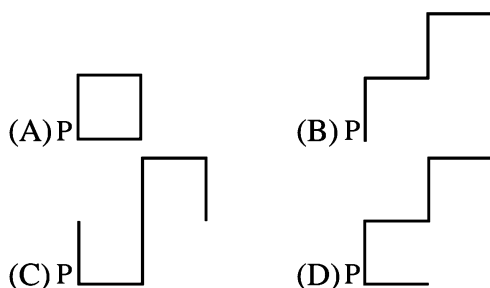
1.110



An ant is at the bottom-left corner of a grid (point P) as shown above. It aims to move to the top right corner of the grid. The ant moves only along the lines marked in the grid such that the current distance to the top-right corner strictly decreases.

Which one of the following is a part of a possible trajectory of the ant during the movement?

[EE]



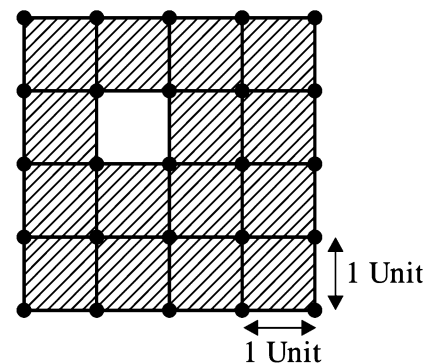
- 1.111 A trapezium has vertices marked as P , Q , R and S (in that order anticlockwise). The side PQ is parallel to side SR . Further, it is given that, $PQ = 11$ cm, $QR = 4$ cm, $RS = 6$ cm and $SP = 3$ cm.

What is shortest distance between PQ and SR (in cm)?

[ECE]

- (A) 4.20 (B) 1.80
(C) 5.76 (D) 2.40

- 1.112 The figure shows a grid formed by a collection of the unit squares. The unshaded unit square in the grid represents a hole.



What is the maximum number of squares without a “hole in the interior” that can be formed within the 4×4 grid using the unit squares as building blocks?

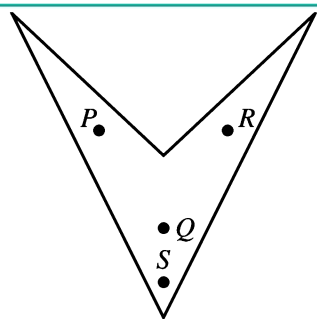
[ECE]

- (A) 26 (B) 21
(C) 15 (D) 20

- 1.113 An art gallery engages a security guard to ensure that the items displayed are protected. The diagram below represents the plan of the gallery where the boundary walls are opaque. The location the security guard posted is identified such that all the inner space (shaded region in the plan) of the gallery is within the line of sight of the security guard.

If the security guard does not move around the posted location and has a 360° view, which one of the following correctly represents the set of ALL possible locations among the locations P , Q , R and S , where the security guard can be posted to watch over the entire inner space of the gallery.

[ECE]



- (A) P and Q (B) Q and S
(C) R and S (D) Q

1.114 Consider the following square with the four corners and the center marked as P , Q , R , S and T respectively.

Let X , Y and Z represent the following operations:

X : rotation of the square by 180 degree with respect to the S - Q axis.

Y : rotation of the square by 180 degree with respect to the P - R axis.

Z : rotation of the square by 90 degree clockwise with respect to the axis perpendicular, going into the screen and passing through the point T .

Consider the following three distinct sequences of operation (which are applied in the left to right order).

- (1) $XYZZ$ (2) XY
(3) $ZZZZ$

Which one of the following statements is correct as per the information provided above?

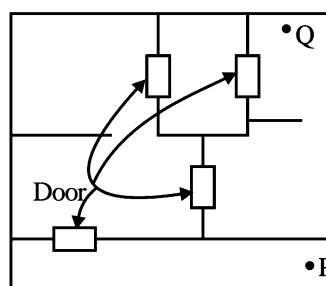
[ECE]

- (A) The sequence of operations 1, 2 and 3 are equivalent
(B) The sequence of operations 2 and 3 are equivalent
(C) The sequence of operations 1 and 3 are equivalent
(D) The sequence of operations 1 and 2 are equivalent

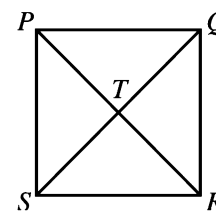
1.115 A building has several rooms and doors as shown in the top view of the building given below. The doors are closed initially.

What is the minimum number of doors that need to be opened in order to go from the point P to the point Q ?

[IN, CH, PI]

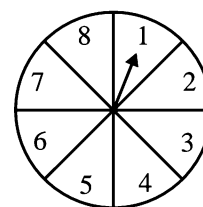
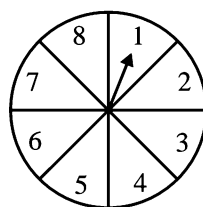


- (A) 1 (B) 4
(C) 2 (D) 3



1.116 A game consists of spinning an arrow around a stationary disc as shown below. When the arrow comes to rest, there are eight equally likely outcomes. It could come to rest in any one of the sectors numbered 1, 2, 3, 4, 5, 6, 7 or 8 as shown. Two such disks are used in a game where their arrows are independently spun. What is the probability that the sum of the numbers on the resulting sectors upon spinning the two disks is equal to 8 after the arrows come to rest?

[IN, CH, PI]



- (A) $\frac{5}{64}$ (B) $\frac{3}{32}$
(C) $\frac{1}{16}$ (D) $\frac{7}{64}$

1.117 Consider the following inequalities,

(i) $3p - q < 4$ (ii) $3q - p < 12$

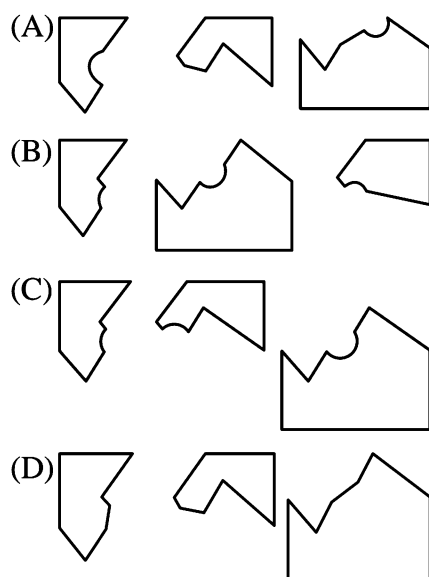
Which one of the following expressions below satisfies the above two inequalities?

[IN, CH, PI]

- (A) $p + q < 8$ (B) $p + q \geq 16$
 (C) $8 \leq p + q < 16$ (D) $p + q = 8$

1.118 Which one of the following sets of pieces can be assembled to form a square with a single round hole near the center? Pieces cannot overlap.

[IN, CH, PI]



1.119 Given the statements :

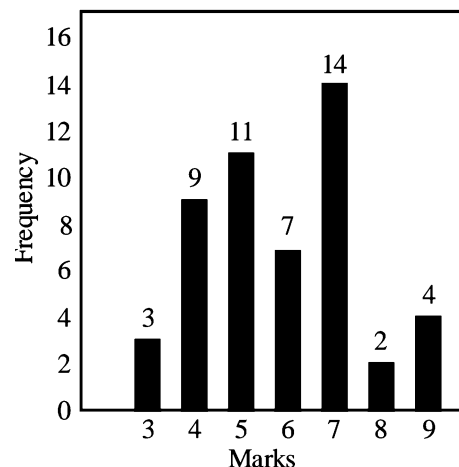
- * P is the sister of Q
- * Q is the husband of R
- * R is the mother of S
- * T is the husband of P

Based on the above information, T is _____ of S.

[CE-1]

- (A) The grandfather (B) An uncle
 (C) The father (D) A brother

1.120



The above frequency chart shows the frequency distribution of marks obtained by a set of student in an exam.

From the data presented above, which one of the following is CORRECT?

[CE-1]

- (A) Mode > Mean > Median
 (B) Median > Mode > Mean
 (C) Mean > Mode > Median
 (D) Mode > Median > Mean

1.121 In the square grid shown on the left, a person standing at P2 position is required to move to P5 position.

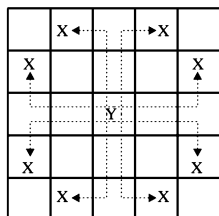
The only movement allowed for a step involves, “two moves along one direction followed by one move in a perpendicular direction”. The permissible directions for movement are shown as dotted arrows in the right.

For example, a person at a given position Y can move only to the positions marked X on the right.

Without occupying any of the shaded squares at the end of each step, the minimum number of steps required to go from P2 to P5 is

[CE-1]

	1	2	3	4	5
P		☺			
Q					
R					
S					
T					



Example : Allowed steps for a person at Y

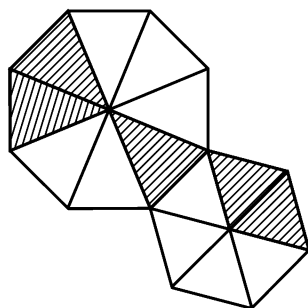
(A) 4

(B) 5

(C) 6

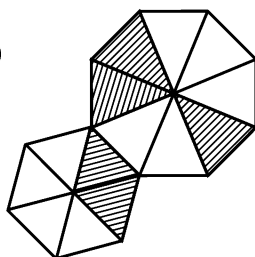
(D) 7

- 1.122** For the picture shown above which one of the following is the correct picture representing reflection with respect to the mirror shown as the dotted line?

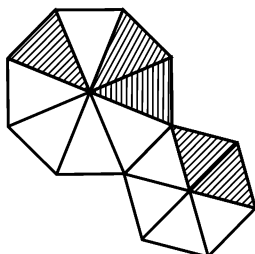


[CE-2]

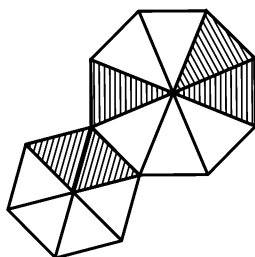
(A)



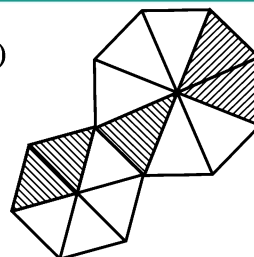
(B)



(C)



(D)



- 1.123** Four girls P, Q, R and S are studying languages in a University. P is learning French and Dutch. Q is learning Chinese and Japanese. R is learning Spanish and French. S is learning Dutch and Japanese. Given that: French is easier than Dutch; Chinese is harder than Japanese; Dutch is easier than Japanese, and Spanish is easier than French.

Based on the above information, which girl is learning the most difficult pair of languages?

[ME-1]

(A) P

(B) Q

(C) R

(D) S

2023 IIT Kanpur

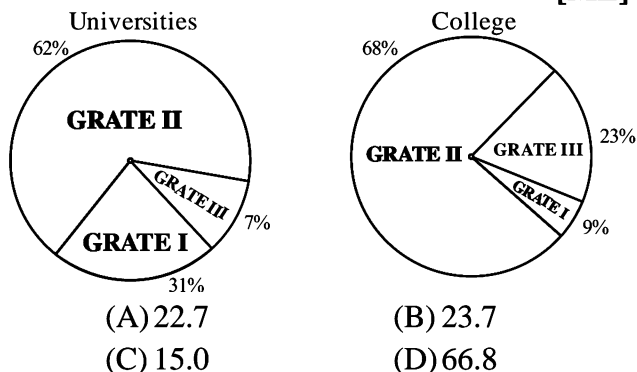
- 1.124** Looking at the surface of a smooth 3-dimensional object from the outside, which one of the following options is TRUE?

- (A) The surface of the object may be concave in some places and convex in other places.
 (B) The surface of object must be concave everywhere.
 (C) The surface of object must be convex everywhere.
 (D) The object can have edges, but no corners.

- 1.125** A certain country has 504 universities of 25951 colleges. These are categorized into grade 1, 2, 3 as shown in the given pie charts. What is the percentage, correct to one decimal place, of higher

education institutions (colleges and universities) that fall into Grade III?

[ME]



1.126 The symbol $\circ \star \triangle \square$ are to be filled one in each box, as shown below.

The rule for filling in the 4 symbols are as follows.

1. Every row and every column must contain each of the 4 symbols.
2. Every 2×2 square delineated by bold lines must contain each of the 4 symbols.

Which symbol will occupy the box marked with '?' in the partially filled figure?

[ME]

	?		$\triangle$
	$\circ$	$\star$	
		$\square$	$\star$
$\star$		$\triangle$	$\circ$

- (A) $\circ$ (B) $\star$
(C) $\triangle$ (D) $\square$

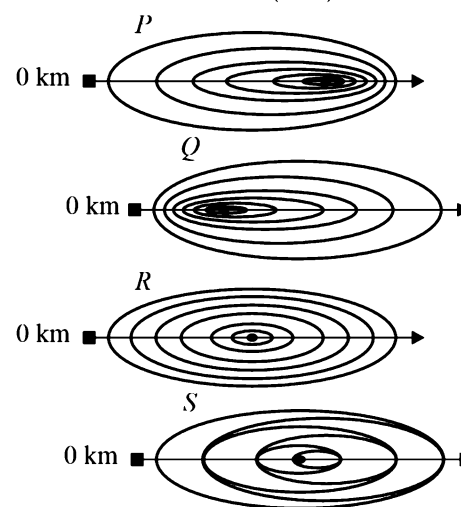
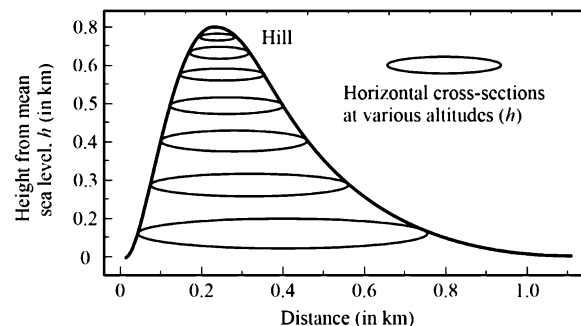
1.127 A $100\text{ cm} \times 32\text{ cm}$ rectangular sheet is folded 5 times. Each time the sheet is folded, the long edge aligns with its opposite side. Eventually, the folded sheet is a rectangle of dimensions $100\text{ cm} \times 1\text{ cm}$.

The total number of creases visible when the sheet is unfolded is _____. [ECE]

- (A) 32 (B) 5
(C) 31 (D) 63

1.128 In the given diagram, ovals are marked at different heights (h) of a hill. Which one of the following options P , Q , R and S depicts the top view of the hill?

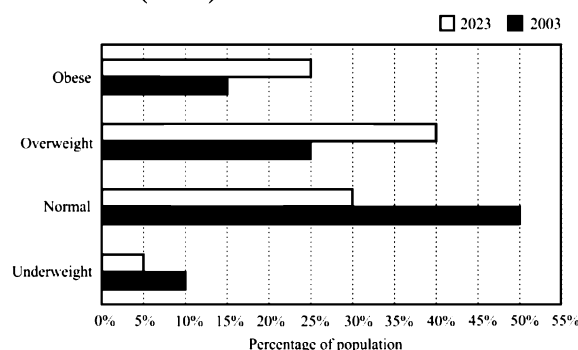
[IN, XE]



- (A) P (B) Q
(C) R (D) S

2024 IISc Bangalore

1.129 The bar chart shows the data for the percentage of population falling into different categories based on Body Mass Index (BMI) in 2003 and 2023.



Based on the data provided, which one of the following options is INCORRECT ?

- (A) The ratio of the percentage of population falling into overweight category to the percentage of population falling into normal category has increased in 20 years.
- (B) The ratio of the percentage of population falling into underweight category to the percentage of population falling into normal category has decreased in 20 years.
- (C) The ratio of the percentage of population falling into obese category to the percentage of population falling into normal category has decreased in 20 years.
- (D) The percentage of population falling into normal category has decreased in 20 years.

[ECE]

- 1.130** *P* and *Q* have been allotted a hostel room with two beds, a study table, and an Almirah. *P* is an avid bird-watcher and wants to sit at the table and watch birds outside the window. *Q* does not mind that as long as his bed is close to the ceiling fan.

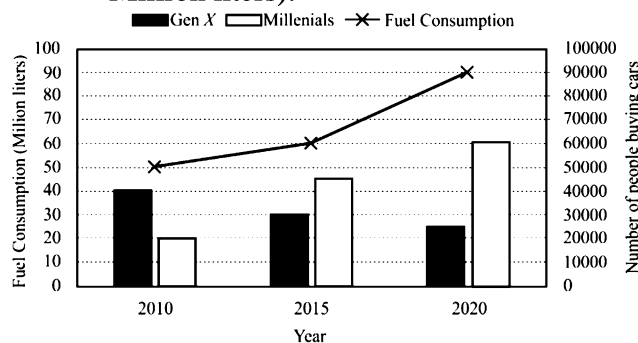
Which one of the following arrangements suits them the most?

- (A)
-
- (B)
-

- (C)
-
- (D)
-

[EE]

- 1.131** The chart below shows the data of the number of cars bought by Millennials and Gen C people in a country from the year 2010 to 2020 as well as the yearly fuel consumption of the country (in Million liters).



Considering the data presented in the chart, which one of the following options is true?

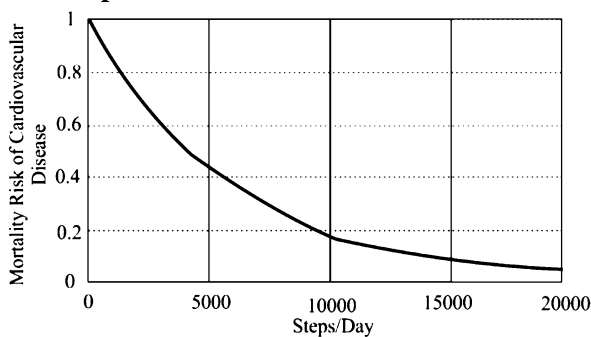
- (A) The percentage increase in fuel consumption from 2010 to 2015 is more than the percentage increase in fuel consumption from 2015 to 2020.
- (B) The increase in the number of Millennial car buyers from 2015 to 2020 is less than the decrease in the number of Gen X car buyers from 2010 to 2015.
- (C) The increase in the number of Millennial car buyers from 2010 to 2015 is more than the decrease in the

number of Gen X car buyers from 2010 to 2015.

- (D) The decrease in the number of Gen X car buyers from 2015 to 2020 is more than the increase in the number of Millennial car buyers from 2010 to 2015.

[EE]

- 1.132 The plot below shows the relationship between the mortality risk of cardiovascular disease and the number of steps a person walks per day. Based on the data, which one of the following options is true ?

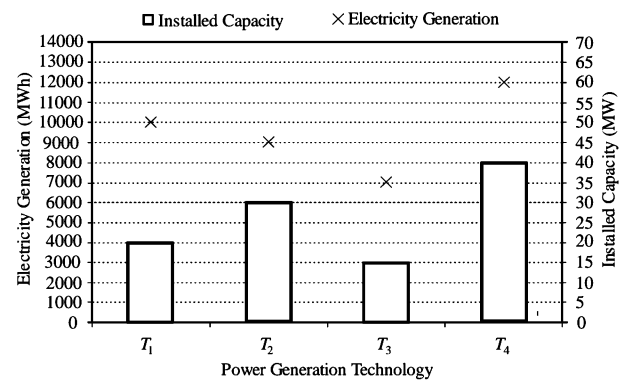


- (A) The risk reduction on increasing the steps/day from 0 to 10000 is less than the risk reduction on increasing the steps/day from 10000 to 20000.
- (B) The risk reduction on increasing the steps/day from 0 to 5000 is less than the risk reduction on increasing the steps/day from 15000 to 20000.
- (C) For any 5000 increment in steps/day the largest risk reduction occurs on going from 0 to 5000
- (D) For any 5000 increment in steps/day the largest risk reduction occurs on going from 15000 to 20000

[IN, CE-2]

- 1.133 The chart given below compares the Installed Capacity (MW) of four power generation technologies, T_1, T_2, T_3 and T_4

and their Electricity Generation (MWh) in a time of 1000 hours (h).



The Capacity Factor of a power generation technology is :

Capacity Factor

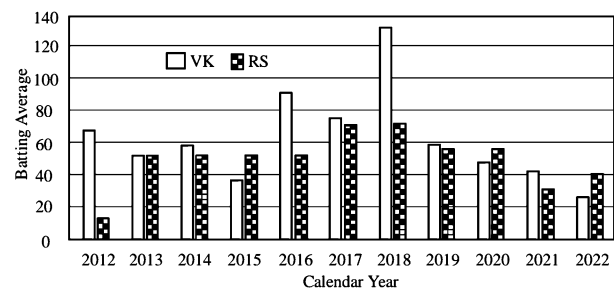
$$= \frac{\text{Electricity Generation (MWh)}}{\text{Installed Capacity (MW)} \times 1000 \text{ (h)}}$$

Which one of the given technologies has the highest Capacity Factor?

- (A) T_1 (B) T_2
(C) T_3 (D) T_4

[CE-1, CH]

- 1.134 The bar chart gives the batting averages of VK and RS for 11 calendar years from 2012 to 2022. Considering that 2015 and 2019 are world cup years, which one of the following options is true?



- (A) RS has a higher yearly batting average than that of VK in every world cup year.
- (B) VK has a higher yearly batting average than that of RS in every world cup year.

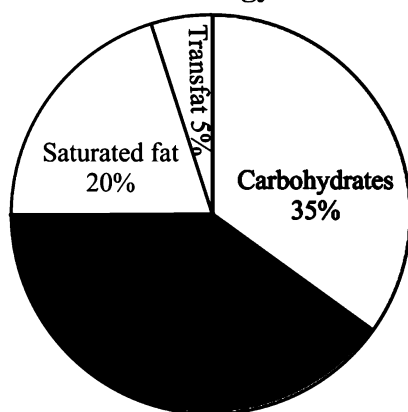
(C) VK's yearly batting average is consistently higher than that of RS between the two world cup years.

(D) RS's yearly batting average is consistently higher than that of VK in the last three years.

[ME]

- 1.135** The pie chart presents the percentage contribution of different macronutrients to a typical 2,000 kcal diet of a person.

Macronutrient energy contribution



The typical energy density (kcal/g) of these macronutrients is given in the table.

Macronutrient	Energy density (kcal/g)
Carbohydrates	4
Proteins	4
Unsaturated fat	9
Saturated fat	9
Trans fat	9

The total fat (all three types), in grams, this person consumes is

- (A) 44.4 (B) 77.8
(C) 100 (D) 3,600

[CS-1]

- 1.136** In an engineering college of 10,000 students. 1,500 like neither their core branches nor other branches. The number of students who like their core branches

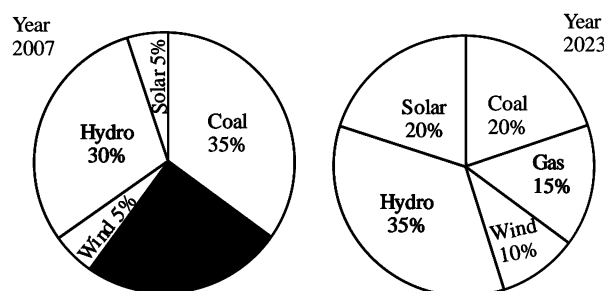
is $\frac{1}{4}$ th of the number of students who like other branches. The number of students who like both their core and other branches is 500.

The number of students who like their core branches is

- (A) 1,800 (B) 3,500
(C) 1,600 (D) 1,500

[CS-2]

- 1.137** The pie charts depict the shares of various power generation technologies in the total electricity generation of a country for the years 2007 and 2023.



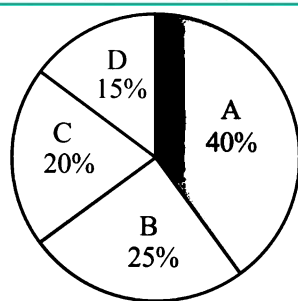
The renewable sources of electricity generation consist of Hydro, Solar and Wind.

Assuming that the total electricity generated remains the same from 2007 to 2023. What is the percentage increase in the share of the renewable sources of electricity generation over this period?

- (A) 25% (B) 50%
(C) 77.5% (D) 62.5 %

[CS-2]

- 1.138** In an election, the share of valid votes received by the four candidates A, B, C , and D is represented by the pie chart shown. The total number of votes cast in the election were 1,15,000, out of which 5,000 were invalid.



Based on the data provided, the total number of valid votes received by the candidates *B* and *C* is

- (A) 45,000 (B) 49,500
(C) 51,750 (D) 54,000

[PI, DA]

- 1.139** Person 1 and Person 2 invest in three mutual funds *A*, *B*, and *C*. The amounts they invest in each of these mutual funds are given in the table.

	Mutual fund A	Mutual fund B	Mutual fund C
Person 1	Rs. 10,000	Rs. 20,000	Rs. 20,000
Person 2	Rs. 20,000	Rs. 15,000	Rs. 15,000

At the end of one year, the total amount that Person 1 gets is Rs. 500 more than Person 2. The annual rate of return for the mutual funds *B* and *C* is 15% each. What is the annual rate of return for the mutual fund *A* ?

[PI, DA]

- (A) 7.5% (B) 10%
(C) 15% (D) 20%

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- 1.140** The table lists the top 5 nations according to the number of gold medals won in a tournament; also included are the number of silver and the bronze medals won by them. Based only on the data provided in

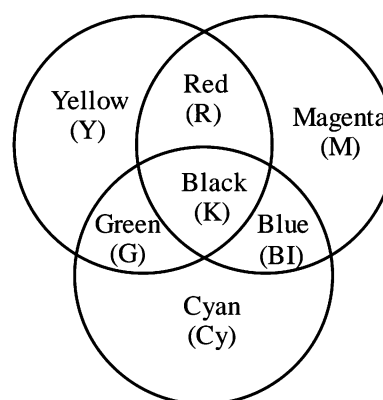
the table, which one of the following statements is INCORRECT? [ECE]

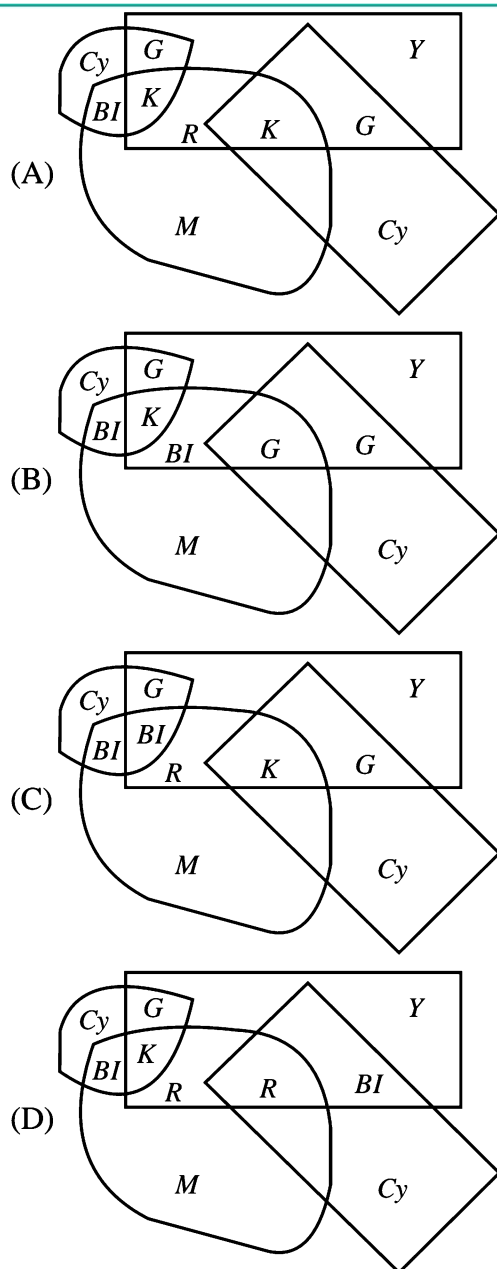
Nation	Gold	Silver	Bronze
USA	40	44	41
Canada	39	27	24
Japan	20	12	13
Australia	17	19	16
France	16	26	22

- (A) France will occupy the third place if the list were made on the basis of the total number of medals won.
(B) The order of the top two nations will not change even if the list is made on the basis of the total number of medals won.
(C) USA and Canada together have less than 50% of the medals awarded to the nations in the above table.
(D) Canada has won twice as many total medals as Japan.

- 1.141** A color model is shown in the figure with color codes: Yellow (Y), Magenta (M), Cyan (Cy), Red (R), Blue (Bl), Green (G), and Black (K). Which one of the following options displays the color codes that are consistent with the color model?

[CE-1, CH]





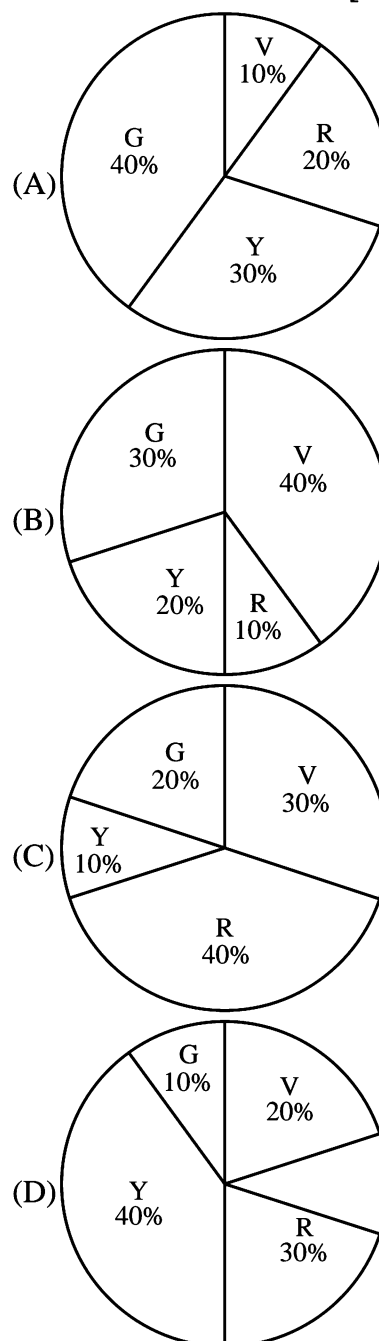
1.142 A bag contains Violet (V), Yellow (Y), Red (R), and Green (G) balls. On counting them, the following results are obtained :

- (i) The sum of Yellow balls and twice the number of Violet balls is 50.
- (ii) The sum of Violet and Green balls is 50.
- (iii) The sum of Yellow and Red balls is 50.

(iv) The sum of Violet and twice the number of Red balls is 50.

Which one of the following Pie charts correctly represents the balls in the bag?

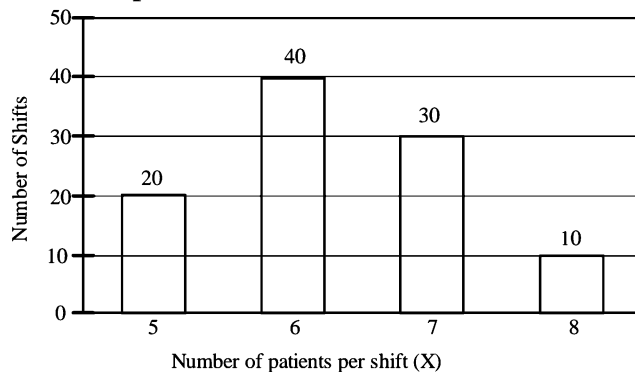
[CE-2, XE]



1.143 The number of patients per shift (X) consulting Dr. Gita in her past 100 shifts is shown in the figure. If the amount she earns is Rs 1000(X – 0.2), what is the

average amount (in she has earned per shift in the past 100 shifts?

Note : The figure shown is representative. **[PI, DA]**



- (A) 6,100 (B) 6,300
(C) 6,000 (D) 6,500

Engineering Services Examination (ESE)

1. Each of four siblings (Anita, Tony, Maria and Jose) is given 5000 to invest in the stock market. Each chooses a different stock. One chooses a utility stock, another an automotive stock, another a technology stock, and the other an oil stock.

- Anita and the owner of the utility stock purchased their shares through an online brokerage, whereas Tony and the owner of the automotive stock did not.
- The gain in value of Maria's stock is twice the gain in value of the automotive stock.
- The technology stock is traded on NASDAQ, whereas the stock that Tony bought is traded on the New York Stock Exchange.

From the above clues, match the name of the sibling and stock bought.

- (A) Maria: the utility stock; Jose: the automotive stock; Anita: the technology stock; Tony: the oil stock

- (B) Maria: the utility stock; Anita: the automotive stock; Jose: the technology stock; Tony: the oil stock
(C) Maria: the utility stock; Tony: the automotive stock; Anita: the technology stock; Jose: the oil stock
(D) Jose: the utility stock; Maria: the automotive stock; Anita: the technology stock; Tony: the oil stock

[ESE 2024]

2. Fifty people were asked to rank their preferences of five varieties of chocolate candy, using 1 for their favorite and 5 for their least favorite. The results are shown in the table below.

	Ranking					
Caramel center	5	4	4	4	2	4
Vanilla center	1	5	5	5	5	5
Almond center	2	3	2	1	3	3
Toffee center	4	1	1	3	4	2
Solid chocolate	3	2	3	2	1	1
Number of voters	17	11	9	8	3	2

According to the table (see the column in grey), three voters ranked solid chocolate first, caramel centers second, almond centers third, toffee centers fourth, and vanilla centers fifth. According to this table, which variety of candy would win the taste test using the plurality voting system?

- (A) Almond centers
(B) Vanilla centers
(C) Toffee centers
(D) Caramel centers

[ESE 2024]

3. The members of a club are going to elect a president from four nominees. In each first-place vote receives 4 points, each

second-place vote receives 3 points, each third-place vote receives 2 points, and each last place vote receives 1 point. If the 100 members of the club mark their ballots as shown in the table below, who will be elected president?

	Ranking					
Avalon	2	2	2	2	3	2
Branson	1	4	4	4	2	1
Columbus	3	3	1	3	1	3
Dunkirk	4	1	3	1	4	4
Number of voters	30	24	18	12	10	6

(A) Avalon

(B) Branson

(C) Columbus

(D) Dunkirk

[ESE 2024]

Answers	Data Interpretation
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1.1	B	1.2	B	1.3	D	1.4	C	1.5	A
1.6	B	1.7	A	1.8	C	1.9	D	1.10	D
1.11	B	1.12	A	1.13	140	1.14	A	1.15	D
1.16	B	1.17	D	1.18	D	1.19	D	1.20	20000
1.21	22	1.22	C	1.23	B	1.24	B	1.25	B
1.26	D	1.27	B	1.28	A	1.29	A	1.30	32
1.31	C	1.32	A	1.33	B	1.34	B	1.35	B
1.36	D	1.37	A	1.38	D	1.39	C	1.40	B
1.41	A	1.42	D	1.43	C	1.44	120	1.45	C
1.46	B	1.47	A	1.48	C	1.49	A	1.50	B
1.51	C	1.52	B	1.53	C	1.54	D	1.55	B
1.56	C	1.57	D	1.58	B	1.59	B	1.60	C
1.61	C	1.62	C	1.63	B	1.64	C	1.65	A
1.66	A	1.67	D	1.68	B	1.69	C	1.70	C
1.71	A	1.72	D	1.73	B	1.74	B	1.75	B
1.76	C	1.77	D	1.78	B	1.79	D	1.80	B
1.81	B	1.82	D	1.83	D	1.84	A	1.85	A
1.86	B	1.87	A	1.88	B	1.89	A	1.90	B
1.91	A	1.92	C	1.93	B	1.94	D	1.95	B
1.96	B	1.97	A	1.98	C	1.99	B	1.100	A
1.101	C	1.102	A	1.103	B	1.104	A	1.105	D
1.106	C	1.107	C	1.108	D	1.109	B	1.110	B
1.111	D	1.112	D	1.113	B	1.114	C	1.115	C
1.116	D	1.117	A	1.118	C	1.119	B	1.120	D
1.121	B	1.122	D	1.123	B	1.124	A	1.125	A
1.126	B	1.127	C	1.128	B	1.129	C	1.130	A
1.131	C	1.132	C	1.133	A	1.134	C	1.135	C
1.136	A	1.137	D	1.138	B	1.139	B	1.140	C
1.141	A	1.142	A	1.143	A				
Engineering Services Examination (ESE)									
1.	A	2.	C	3.	B				

Explanations	Data Interpretation
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1.1 (B)

Suppose : Hari's age : H , Gita's age : G , Saira's age : S , Irfan's age : I

According to question,

1. $H + G > I + S$

2. G can't be oldest and S can't be youngest.

$$G - S = 1 \text{ or } S - G = 1$$

3. There are no twins. Thus using statement (2) either GS or SG possible.

Checking from the options,

Option (A) : HSIG

Not possible as there is I between S and G which is not possible using statement (2).

So, incorrect option.

Option (B) : SGHI

SG order is possible.

$$S > G > H > I$$

Therefore, $S = G + 1$ and $H + G > I + S$

$$H + G > I + G + 1 \Rightarrow H > I + 1$$

and $H \neq I$ which is possible

[From statement (3)] satisfying all the facts.

So, correct option.

Option (C) : IGSH

According to this $G = S + 1$ and

$$H + G > I + S$$

$$H + S + 1 > I + S$$

$$H + 1 > I$$

and $H \neq I$ [from statement (3)]

Therefore, $H > I$

But in option $H < I$.

So, incorrect option.

Option (D) : IHSG

According to this $I > H$ and $S > G$ thus adding both inequalities $I + S > H + G$ which is opposite to statement (1), thus not possible.

Hence, the correct option is (B).

1.2 (B)

Fuel consumed per km will be least when mileage (kilometers per litres) mentioned on y axis of graph will be maximum irrespective of number of kilometers travelled.

From the graph (y axis), the mileage (kilometers per litres) is maximum when vehicle is driven at

45 kilometers per hour. Hence the stretch which Q covered at 45 kmph, mileage was highest and fuel consumption per kilometers was lowest.

Hence, the correct option is (B).

1.3 (D)

Method 1

In the given graph,

X - Coordinate : Number of miligrams of microbe required to destroy half of the body mass in kilogram.

Therefore, lesser the miligrams of microbe required, more is the danger to humans.

Y - Coordinate : Probability that microbe will overcome human immunity system. Therefore, more probability is danger to humans.

In the given graph, microbe S requires only 200 mg of toxicity to destroy half of the body mass in kg and it has highest probability to overcome human immunity system.

Hence, the correct option is (D).

Method 2

According to given information,

Most dangerous microbe

$\propto$ Probability that microbe will overcome human immune system

$\propto$ Area (growth of microbe)

$$\propto \frac{1}{\text{Quantity required}}$$

So, most dangerous microbe

$$\propto \frac{\text{Probability} \times \text{Area}}{\text{Quantity required}}$$

$$= \frac{K \times \text{Probability} \times \text{Area}}{\text{Quantity required}}$$

Where K is proportionality constant

$$= \frac{K \times \text{Probability} \times \pi d^2}{4 \times \text{Quantity required}}$$

For microbe P

$$\begin{aligned}\text{Most dangerous microbe} &= \frac{\pi K}{4} \left(\frac{0.4 \times 50^2}{800} \right) \\ &= \frac{\pi K}{4} \left(\frac{5}{4} \right)\end{aligned}$$

For microbe Q

$$\begin{aligned}\text{Most dangerous microbe} &= \frac{\pi K}{4} \left(\frac{0.5 \times 40^2}{600} \right) \\ &= \frac{\pi K}{4} \left(\frac{4}{3} \right)\end{aligned}$$

For microbe R

$$\begin{aligned}\text{Most dangerous microbe} &= \frac{\pi K}{4} \left(\frac{0.4 \times 30^2}{300} \right) \\ &= \frac{\pi K}{4} \left(\frac{6}{5} \right)\end{aligned}$$

For microbe S

$$\begin{aligned}\text{Most dangerous microbe} &= \frac{\pi K}{4} \left(\frac{0.8 \times 20^2}{200} \right) \\ &= \frac{\pi K}{4} \left(\frac{8}{5} \right)\end{aligned}$$

From this we can say that most dangerous microbe is S.

Hence, the correct option is (D).

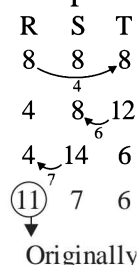
1.4 (C)

Given : In the last, three sisters were left with equal number of Toys.

And total Toys is 24.

At the last R S T will have 8, 8, 8 Toys.

If we reverse the process of gift exchange, we get



Hence, the correct option is (C).

1.5 (A)

Given :

The contribution of each factor to the overall service quality is directly proportional to the factor score and its standardized coefficient.

So, contribution $\propto$ (factor score) $\times$ (standardized coefficient)

- Contribution of outcome factor
 $= Q \times \text{factor score} \times \text{standardized coefficient}$
 $= Q \times 6 \times 0.8$
 $= 4.8 \times Q = 4.8$ (Here, Q is the proportional constant assumed to be 1...)

Similarly,

- Contribution of tangibles
 $= 5 \times 0.4 = 2$
- Contribution of reliability
 $= 6 \times 0.7 = 4.2$
- Contribution of responsiveness
 $= 6 \times 0.6 = 3.6$
- Contribution of empathy
 $= 4 \times 0.6 = 2.4$
- Contribution of assurance
 $= 6 \times 0.5 = 3$

So, we can see here lowest contribution is “2” and total contribution is

$$4.8 + 2 + 4.2 + 3.6 + 2.4 + 3 = 20$$

The lowest contribution among all the above factors to the overall quality of services delivered by the company

$$= \left(\frac{2}{20} \right) \times 100 = 10\%$$

Hence, the correct option is (A).

1.6 (B)

Given :

Round	P	Q	R	S
1	1	5	1	10
2	5	10	10	1

3	1	1	1	5
4	10	10	1	1
5	1	5	5	10
6	10	5	1	1
7	5	10	1	1

Here the most accurate player will be the one who makes the highest score.

Q has the maximum score of 46 points among all other players, so Q is the most accurate player.

The most consistent player will be the one who has the minimum standard deviation. [The standard deviation is given by the square root of the sum of the squares of the individual deviations from mean divided by the number of items.] Here, mean values for P , Q , R and S are :

$$\frac{33}{7} = 4.71, \frac{46}{7} = 6.57, \frac{20}{7} = 2.85$$

$$\text{and } \frac{29}{7} = 4.14 \text{ respectively.}$$

For P , the standard deviation is :

$$\sqrt{\frac{3 \times 3.71^2 + 2 \times 0.29^2 + 2 \times 5.29^2}{7}} = 3.73$$

For Q , the standard deviation is :

$$\sqrt{\frac{1 \times 5.57^2 + 3 \times 1.57^2 + 3 \times 3.43^2}{7}} = 3.24$$

For R , the standard deviation is :

$$\sqrt{\frac{5 \times 1.85^2 + 1 \times 2.15^2 + 1 \times 7.15^2}{7}} = 3.22$$

For S , the standard deviation is :

$$\sqrt{\frac{4 \times 3.14^2 + 1 \times 0.86^2 + 2 \times 5.86^2}{7}} = 3.93$$

R has the minimum standard deviation and is the most consistent player.

Hence, the correct option is (B).

Key Point

Mean :

$$\bar{x} = \frac{1}{n} \times \sum_{i=1}^n x_i$$

Standard Deviation (SD) :

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2}$$

1.7 (A)

Given sequence : AD CG FK JP

(i) A _ _ D (2 spaces)

(ii) C _ _ _ G (3 spaces)

(iii) F _ _ _ _ K (4 spaces)

(iv) J _ _ _ _ _ P (5 spaces)

The space between each term is increasing by 1 and the 1st alphabet of the consecutive term is one less than last alphabet of the previous term.

Therefore, the 5th term will have 6 spaces and start from ' P '-1 i.e. ' O '.

So, the next term is OV.

Hence, the correct option is (A).

1.8 (C)

Given :

Country	Number of Tourists
USA	2000
England	3500
Germany	1200
Italy	1100
Japan	2400
Australia	2300
France	1000

Total number of tourists who visited

India in

$$2011 = 2000 + 3500 + 1200 + 1100 + 2400$$

$$+ 1000 + 2300$$

$$= 13500$$

$$\text{One-third of total tourists} = \frac{13500}{3} = 4500$$

The two countries contributed to 1/3rd of total tourists are England and France

Since, England = 3500

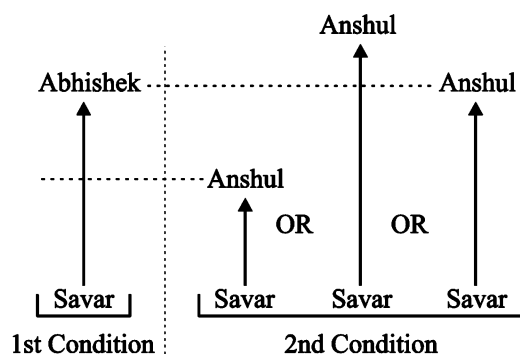
France = 1000

and $E + F = 4500$

Hence, the correct option is (C).

1.9 (D)

According to the question,



Since, there is no information given about the relationship between Anshul and Abhishek. So no conclusion can be made from the given information.

Hence, the correct option is (D).

1.10 (D)

Following statements can be derived from the given diagram :

- Butterflies are shown in birds category.
- The area corresponding to the tiger in pie chart is larger than that of red ants.
- There are only two types of reptiles i.e. snakes and crocodiles.
- It is not correct as the size of animals is not specified in the pie chart but the numbers are specified.

Elephants are in largest number in mammals.

Hence, the correct option is (D).

1.11 (B)

BEST OF LUCK

B _ST _F L _CK → KCLFTSB

GOOD WISHES

G _ _D W _SH _S → SHSWDG

From above two we can conclude that vowels are missing and then reversed.

Hence,

ACE THE EXAM

_C _ TH _ _X _M

and reverse is MXHTC.

Hence, the correct option is (B).

1.12 (A)

Batsman 'K' is the most consistent because it has minimum standard deviation. Average has no relationship with consistency.

Hence, the correct option is (A).

Key Point

Standard deviation is the difference of a particular value with the calculated mean of all the values (here averages of the batsmen) so the batsman with minimum deviation should be the most consistent batsman.

1.13 140

Ratio of male to female students in year 2008,

$$\frac{M_{2008}}{F_{2008}} = 2.5$$

['F' denotes female and 'M' denotes male]

In year 2009,

$$\frac{M_{2009}}{F_{2009}} = 3$$

$$\frac{M_{2009}}{F_{2009}} = \frac{3}{2.5}$$

$$\frac{M_{2009}}{M_{2008}} \times \frac{F_{2008}}{F_{2009}} = 1.2 \quad \dots (i)$$

Number of female students get doubled in 2009

i.e. $F_{2009} = 2F_{2008}$

From equation (i),

$$\frac{M_{2009}}{M_{2008}} \times \frac{1}{2} = 1.2$$

$$\frac{M_{2009}}{M_{2008}} = 2.4$$

% increase of students in year 2009

$$= \frac{M_{2009} - M_{2008}}{M_{2008}} \times 100$$

$$= \left(\frac{M_{2009}}{M_{2008}} - 1 \right) \times 100$$

$$= (2.4 - 1) \times 100 = 140\%$$

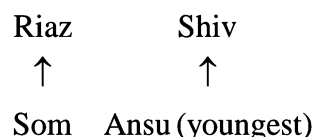
Hence, the correct answer is **140**.

1.14 (A)

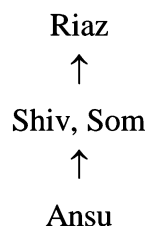
Given : A group has 4 children.

Som is younger to Riaz and Shiv is elder to Ansu.

Ansu is youngest in the group.



Statement 1 : Shiv is younger to Riaz.



Hence, it is clear from statement 1 that Riaz is the eldest children without the requirement of statement 2.

Hence, the correct option is (A).

1.15 (D)

Revenue : It is the income that a business has from its normal business activities, usually from the sales of goods and services to customers; money regularly received by a company.

Given : Total quantity of exports of all the items = 5 lakh tons.

$$1 \text{ ton} = 907.185 \text{ kg}$$

$$5 \text{ lakh tons} = 4.53 \times 10^8 \text{ kg}$$

Total revenue generated = 250 crore rupees.

11% of total export belongs to item 1. Therefore, the quantity of item 1 is given by,

$$Q_1 = 4.53 \times 10^8 \times \frac{11}{100} = 4.98 \times 10^7 \text{ kg}$$

Revenue generated by item 1 is given by,

$$R_1 = 250 \times 10^7 \times \frac{12}{100} = 3 \times 10^8 \text{ Rs.}$$

Hence, the revenue generated through export of item 1 per kg

$$= \frac{3 \times 10^8}{4.98 \times 10^7} \cong \frac{3}{5} \times 10 = 6$$

22% of total exports belongs to item 4.

Therefore, the quantity of item 4 is given by,

$$Q_4 = 4.53 \times 10^8 \times \frac{22}{100} = 9.96 \times 10^7 \text{ kg}$$

Revenue generated by item 4 is given by,

$$R_4 = 250 \times 10^7 \times \frac{6}{100} = 15 \times 10^7 \text{ Rs.}$$

Hence, the revenue generated through export of item 4 per kg

$$= \frac{15 \times 10^7}{9.96 \times 10^7} \cong \frac{15}{10} = 1.5$$

Therefore, the ratio of revenue generated through export of item 1 per kg to the revenue generated through export of item 4 per kg is given by,

$$\text{Ratio} = \frac{6}{1.5} = \frac{4}{1}$$

Hence, the correct option is (D).

1.16 (B)

Form	Category
P	Resident male income < 10 lakh
Q	Resident female income < 8 lakh
R	Resident male/female income > 10 lakh
S	Non resident income > 15 lakh

Since, a resident female with income in range 8 to 10 lakh does not fall in above categories.

Hence, the correct option is (B).

1.17 (D)

Since, for year 2000, 2001 and 2002 exports are more than imports hence, the concept of trade deficit does not exist.

$$\% \text{ Trade deficit} = \frac{\text{Import} - \text{Export}}{\text{Export}}$$

From option (B) : In 2004,

$$\frac{\text{Import} - \text{Export}}{\text{Export}} = \frac{10}{70} = \frac{1}{7}$$

From option (A) : In 2005,

$$\frac{90 - 80}{80} = \frac{10}{80} = \frac{1}{8}$$

From option (D) : In 2006,

$$\frac{120 - 100}{100} = \frac{20}{100} = \frac{1}{5}$$

From option (C) : In 2007,

$$\frac{110 - 100}{100} = \frac{10}{100} = \frac{1}{10}$$

Hence, the correct option is (D).

1.18 (D)

There are two lights on every step of ladder if one of the light is red (R), the another will be blue (B).

And if one of the light is green (G), the another will be yellow (Y).

Therefore, the number of red lights will be equal to blue lights and the number of green lights will be equal to yellow lights.

Hence, statement 1 and 2 are correct.

$$R = B, G = Y \quad \dots (i)$$

Sum of red and green lights = $R + G$

From equation (i),

$$R + G = B + Y$$

Hence, statement 3 is also correct.

It is very much possible that sum of red and blue lights is not equal to sum of green and yellow lights.

Let us assume that one step of the ladder has one red light, so the other light will be blue.

Now, any number of steps can have green lights. Therefore, statement four is not necessarily correct.

Hence, the correct option is (D).

1.19 (D)

Let, Total reports, $x = 500$ thousand tonnes

Total revenues, $y = 250$ crore rupees

From the given pie charts :

Item	kg	Revenues	Revenue/kg
1.	$0.11x$	$0.12y$	$1.0909(y/x)$
2.	$0.2x$	$0.2y$	(y/x)
3.	$0.19x$	$0.23y$	$1.21(y/x)$
4.	$0.22x$	$0.06y$	$0.27(y/x)$
5.	$0.12x$	$0.2y$	$1.67(y/x)$
6.	$0.16x$	$0.19y$	$1.19(y/x)$

From the table, item-5 has maximum ratio.

Hence, the correct option is (D).

1.20 20000

Let total cost in 2012 = x

Total number of air purifiers sold = 200

Consider x be the total manufacturing cost in 2012.

From pie chart, share of labor in cost = 15%

Expenditure on labour

$$= 15\% \text{ of } x = 4,50,000$$

$$x = 4,50,000 \times \frac{100}{15} = 30,00,000$$

Total profit in 2012 = Rs.10,00,000

Selling price = Rs. 30,00,000 + 10,00,000

= Rs. 40,00,000

Selling price of one air purifiers

$$= \frac{40,00,000}{200} = \text{Rs. } 20,000$$

Hence, the price of each air purifier is **Rs. 20,000**.

1.21 22

Method 1

Let, total cost in 2012 is Rs. 100

Raw material increases in 2013 by 30%,

$$1.3 \times 20 = 26$$

Other expenses increased in 2013 by 20%,

$$1.2 \times 80 = 96$$

Total cost in 2013 = 96 + 26 = 122

Total cost increased by 22%.

Hence, the percentage increased in the total cost for the company in 2013 is **22**.

Method 2

Let total expenses = x

Sr.	Product	Cost	Increment
1.	Raw material	$0.2x$	$0.3 \times 0.2x = 0.06x$ [@ 30%]
2.	Energy	$0.25x$	$0.2 \times 0.25x = 0.05x$ [@ 20%]
3.	Plant & Machinery	$0.3x$	$0.2 \times 0.3x = 0.06x$ [@ 20%]
4.	Transportation	$0.1x$	$0.2 \times 0.1x = 0.02x$ [@ 20%]
5.	Labour	$0.15x$	$0.2 \times 0.15x = 0.03x$ [@ 20%]
	Total	x	$0.22x$

Hence, % increment in total cost = 22%

Hence, the percentage increased in the total cost for the company in 2013 is **22**.

1.22 (C)

Let, x_1 = Number of male students in 2011

x_2 = Number of male students in 2012

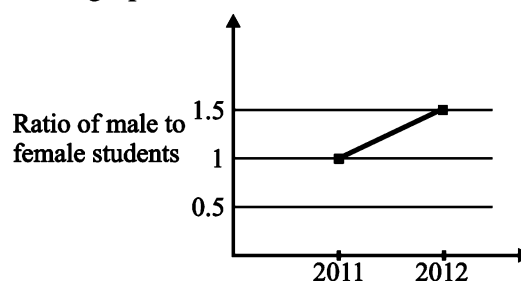
y_1 = Number of female students in 2011

y_2 = Number of female students in 2012

According to the question,

$$y_1 = y_2 = y$$

From the graph,



The ratio of male to female student in 2011,

$$\frac{x_1}{y_1} = \frac{x_1}{y} = 1$$

$$x_1 = y \quad \dots(i)$$

and the ratio of male to female students in 2012,

$$\frac{x_2}{y_2} = \frac{x_2}{y} = 1.5$$

$$x_2 = 1.5y \quad \dots(ii)$$

So the required ratio,

$$\frac{x_2}{x_1} = \frac{1.5y}{y} = 1.5 : 1$$

Hence, the correct option is (C).

1.23 (B)

Given : Total number of floors = 06

- (i) Anuj : Lives on an even-numbered floor.
(2, 4, 6)
- (ii) Bhola : Lives on an even-numbered floor
(2, 4, 6)
- (iii) Chandan : Lives on any of the floor above Faisal's.

- (iv) Dilip : Does not live on floor number 2.
 (v) Eshwar : Does not live on any of the floor above or below bhola.
 (vi) Faisal : Lives 3 floor above Dilip

According to options, Dilip lives either on floor 1 or 3 and Faisal lives either on floor 4 or 5. If Dilip lives on 1st floor then Faisal lives on 4th floor and if Dilip lives on 3rd floor then Faisal lives on 6th floor (not possible because Chandan lives on any of the floor above Faisal's, but there is only 6th floors).

Hence, Dilip → 1st floor

Faisal → 4th floor

From options, option (C) and (D) are incorrect.

Now, Chandan → 5th floor

{From options (A) and (B)}

Eshwar → 3rd floor

Since, Eshwar can not be immediately above or below, Bhola, So Bhola must be living on 6th floor which means Anuj lives on 2nd floor.

Hence, the correct option is (B).

1.24 (B)

Given : The monthly rainfall chart based on 50 years of rainfall in Agra is shown below,

Statement 1 : On average, it rains more in July than in December.

According to the graph, above statement is correct.

Statement 2 : Every year, the amount of rainfall in August is more than that in January.

The graph shows the average rainfall so it is impossible to predict if every years amount of rainfall in August is more than that in January.

Statement 3 : July rainfall can be estimated with better confidence than February rainfall.

Since, the graph shows that the gap between 5 percentile and 95 percentile from average is

higher in February than in July. Therefore, July rainfall can be better estimated than February.

Statement 4 : In August, there is at least 500 mm of rainfall.

This statement may or may not be correct. Since, the graph is average of 50 years.

Hence, the correct option is (B).

1.25 (B)

Given : As per the question, the first and the last sentence of the passage are in proper order and number 1 and 6.

The above question is based on time sequence. Thus, the sentence should be organized in a chronological order clockwise.

Hence, the proper order of above paragraph is,

Sentence	Order
On Diwali, the family rises early in the morning.	1
Father, mother and children visit relatives and exchange gifts and sweets.	5
The whole family, including the young and the old enjoy doing this.	2
At sunset , the lamps are lit and the family performs various rituals.	4
Children let off fireworks later in the night with their friends.	3
Houses looks so pretty with lighted lamps all around.	6

This arrangement makes a logical sequence (5, 2, 4, 3) in clockwise order.

Hence, the correct option is (B).

1.26 (D)

Following table can be drawn from cumulative table :

Stretch	Distance	Electricity used (kWh)	Electricity Consumption per km
M	20	12	$\frac{12}{20} = 0.6$
N	$45 - 20 = 25$	$25 - 12 = 13$	$\frac{13}{25} = 0.52$
O	$75 - 45 = 30$	$45 - 25 = 20$	$\frac{20}{30} = 0.66$
P	$100 - 75 = 25$	$57 - 45 = 12$	$\frac{12}{25} = 0.48$

The electricity consumption per km is minimum for P.

Hence, the correct option is (D).

1.27 (B)

If you look into the given statement there is a gap of one day between 20/5/2014 and 22/5/2014. This means Ms. X will be in Kochi for only one day in may.

Hence, the correct option is (B).

1.28 (A)

Given :

Two floors in a certain buildings are 9 feet apart.

Thus, the height of successive floors = 9 feet

And, the height of each step = $\frac{3}{4}$ feet

So, number of steps = $\frac{9}{(3/4)} = 12$ steps

To find the number of steps, width of step is not required. Hence, only statement I is needed.

Hence, the correct option is (A).

1.29 (A)

The first two statements are appropriate to tackle the situation.

The third statement implies to put a ban on water supply in lower areas which is morally wrong and should not be done.

Hence, the correct option is (A).

1.30 32

Let total number of students = x

Then according to the given pie chart, the number of students are :

Branch	Number of students (In % of x)
Electrical	20% of $x = 0.2x$
Mechanical	10% of $x = 0.1x$
Civil	30% of $x = 0.3x$
Computer Science	40% of $x = 0.4x$

According to question,

The ratio of male to female students in each department = 5 : 4.

and the number of male students in Electrical is,

$$= \frac{5}{5+4} \times 0.2x = 40$$

So, $\frac{x}{9} = 40$

$$x = 360$$

So, the number of female students in Civil

$$= \frac{4}{5+4} \times 0.3x = \frac{4}{9} \times 0.3 \times 360 = 48$$

and the number of female students in Mechanical

$$= \frac{4}{5+4} \times 0.1x = \frac{4}{9} \times 0.1 \times 360 = 16$$

Thus, the required difference is given by,

$$= \text{Female}_{(\text{Civil})} - \text{Female}_{(\text{Mechanical})} \\ = 48 - 16 = 32$$

Hence, the correct answer is 32.

1.31 (C)

Let the weight of each pole = x

Statement (I) : One fourth of the weight of a pole is 5 kg.

$$\frac{x}{4} = 5 \text{ kg} \Rightarrow x = 20 \text{ kg}$$

Total weight of 10 poles = $10x = 200$ kg

Which means that statement (I) is alone sufficient.

Statement (II) :

Total weight of 10 poles = $10x$

Total weight of 2 poles = $2x$

Given $10x - 2x = 160$ kg

$\Rightarrow x = 20$ kg

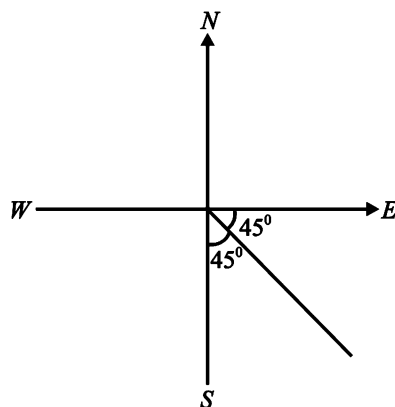
Total weight = $10x = 200$ kg

Which means that statement (II) is alone sufficient.

So, either (I) or (II) alone is sufficient.

Hence, the correct option is (C).

1.32 (A)

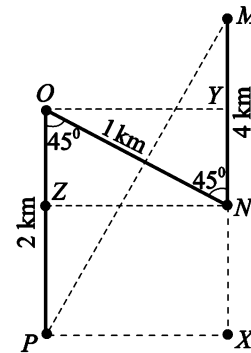
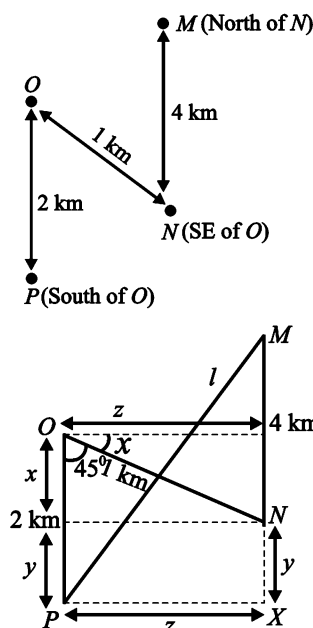


M is north of N , at a distance of 4 km.

P is south of O , at a distance of 2 km

N is south-east of O by 1 km

Distance between M and P is



From ONY triangle,

$$NY = NO \cos 45^\circ = \frac{1}{\sqrt{2}}$$

$$PX = OY = NO \sin 45^\circ = \frac{1}{\sqrt{2}}$$

$$NY = OZ = \frac{1}{\sqrt{2}}$$

Thus, $ZP = NX = 2 - \frac{1}{\sqrt{2}} = 1.3$

$$MX = 4 + 1.3 = 5.3$$

By Pythagoras theorem in $\triangle MXP$,

$$(MP)^2 = (MX)^2 + (PX)^2$$

$$(MP)^2 = 5.3^2 + 0.707^2 \quad [PX = OY]$$

$$MP = 5.34 \text{ km}$$

Hence, the correct option is (A).

1.33 (B)

Given : Tanya is older than Eric and Cliff is older than Tanya.

Cliff
 $\uparrow$
 Tanya
 $\uparrow$
 Eric

From above figure, Cliff is older than Eric if first two statements are true.

Statement 3 : Eric is older than Cliff.

So, it is a false statement.

Hence, the correct option is (B).

1.34 (B)**Given :** ROAD is written as URDG.

By following A – Z alphabetic chart :

R – U : In between two alphabets

O – R : In between two alphabets

A – D : In between two alphabets

D – G : In between two alphabets

So, S T U V
 W X Y Z
 A B C D
 N Q P Q

Hence, the correct option is (B).

1.35 (B)**Given :**

- (i) There are 5 portfolios, home, power, defense, telecom and finance.
- (ii) 6 selected members P, Q, R, S, T and U are to be appointed in 5 portfolios.
- (iii) U does not want any portfolio if S gets one of the five.
- (iv) R wants either Home or Finance or no portfolio.
- (v) Q says that if S gets either Power or Telecom, then she must get the other one. T insists on a portfolio if P gets one.

R wants Home or Finance or no portfolio. In option (A) and (D), R has Defense and Telecom. So, both options are incorrect.

U does not want a portfolio if S gets one of the five. In option (C), S and U both have portfolios. So, option (C) is also incorrect.

Hence, the correct option is (B).

1.36 (D)**Given :** Capacity of a solution tank A is 70% of the capacity of tank B.**Statement I :** Tank A is 80% full and tank B is 40% full.**Statement II :** Tank A if full contains 14,000 gallons of solution.

Statement I can be used to solve the question if capacity of both tanks is already known and statement II can be used if it is known how much each tank is full/empty.

Therefore, by using both statements,

Let capacity of tank B is x ,

$$\text{Then, } \frac{70}{100}x = 14000$$

$$x = 20000 \text{ gallons}$$

Since, tank A was 80% full,

$$A = \frac{80}{100} \times 14000 = 11200 \text{ gallons}$$

Since, tank B was 40% full,

$$B = \frac{40}{100} \times 20000 = 8000 \text{ gallons}$$

$$\begin{aligned} \text{Total solution} &= 11200 + 8000 \\ &= 19200 \text{ gallons} \end{aligned}$$

Hence, the correct option is (D).

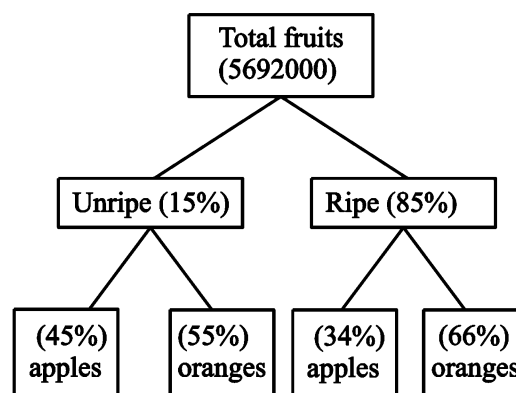
1.37 (A)**Given :** Total fruits = 5692000

Unripe fruits = 15%

Apples in unripe fruits = 45%

Oranges in ripe fruits = 66%

According to the question, following tree diagram can be made.

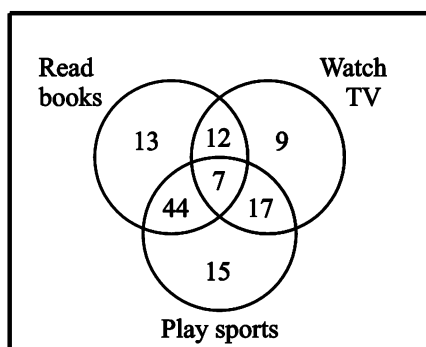


Total number of apples

$$\begin{aligned}
 &= \text{Ripe apples} + \text{Unripe apples} \\
 &= [(0.85 \times 0.34) + (0.15 \times 0.45)] \\
 &\quad \times 5692000 \\
 &= 2029198
 \end{aligned}$$

Hence, the correct option is (A).

1.38 (D)



The number of students who read books,

$$n(R) = 12 + 44 + 7 + 13 = 76$$

The number of students who play sports,

$$n(S) = 44 + 7 + 17 + 15 = 83$$

The number of students who read books and play sports.

$$n(R \cap S) = 44 + 7 = 51$$

The number of students who read books or play sports is given by,

$$n(R \cup S) = n(R) + n(S) - n(R \cap S)$$

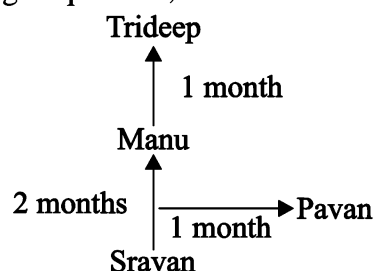
$$n(R \cup S) = 76 + 83 - 51 = 108$$

Hence, the correct option is (D).

1.39 (C)

Given : Total number of students = 04

According to question,



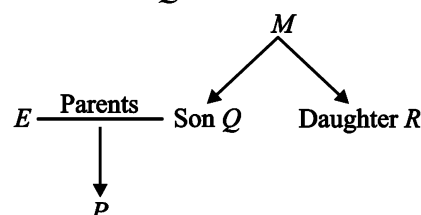
The oldest of all the students occupies the extra space. From above figure, it is clear that Trideep is the oldest.

Hence, the correct option is (C).

1.40 (B)

Given : M has a son Q and a daughter R only.

E is the mother of P and daughter-in-law of M i.e. E is the wife of Q .



From above figure, it is clear that P is the grandchild of M .

Hence, the correct option is (B).

1.41 (A)

Total faculty members = 150

The faculty members having Facebook® account = FB = 55

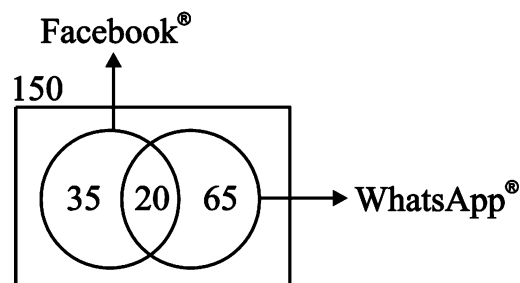
The faculty members having WhatsApp® = W = 85

The faculty members do not have Facebook® (or) WhatsApp® accounts = 30.

The faculty members having any account = 150 - 30 = 120.

The faculty members having both the accounts = (FB + W) - 120 = (55 + 85) - 120 = 20

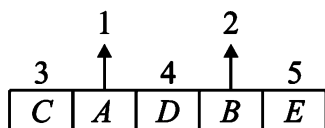
Therefore, the number of faculty members connected only through Facebook® accounts = 55 - 20 = 35



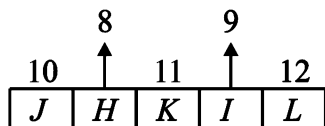
Hence, the correct option is (A).

1.42 (D)

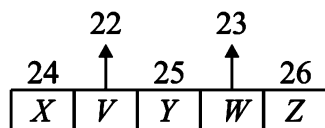
(A)



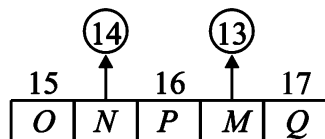
(B)



(C)



(D)



For options (A), (B) and (C) a common pattern follows.

The 2nd, 4th, 1st, 3rd, 5th letters are consecutive alphabets.

For example, in option (B) : *JHKIL*

H - 2nd letter

I - 4th letter

J - 1st letter

K - 3rd letter

L - 5th letter

Option (D) does not follow this pattern.

Hence, the correct option is (D).

1.43 (C)**Method 1**

In given 2×4 rectangle grid, the following type of rectangles are present :

One figured rectangles = 8

Two figured rectangles = 10

Three figured rectangles = 4

Four figured rectangles = 5

Six figured rectangles = 2

Eight figured rectangles = 1

So, total number of rectangles = 30

Hence, the correct option is (C).

Method 2

No. of rows in given cell = 2

No. of column in given cell = 4

Formula :

$$\begin{aligned} \text{Total number of cells} &= \frac{R(R+1)}{2} \times \frac{C(C+1)}{2} \\ &= \frac{2(2+1)}{2} \times \frac{4(4+1)}{2} = 30 \end{aligned}$$

Hence, the correct option is (C).

Method 3

Formula : Total number of cells =

Addition of no. of rows $\times$ Addition of no. of columns

$$= (1+2) \times (1+2+3+4) = 3 \times 10 = 30$$

Hence, the correct option is (C).

1.44 120

Installed capacity $\geq$ 200 tonnes

$\Rightarrow$ large plant

Installed capacity $<$ 200 tonnes

$\Rightarrow$ small plant

From given graph, the large plants are 1, 4, 8 & 9

Total production of large plants

$$= 160 + 190 + 230 + 190 = 770 \text{ tonnes}$$

Total production of small plants

$$= 150 + 160 + 120 + 100 + 120$$

$$= 650 \text{ tonnes}$$

The difference between total production of large plants and small plants in tonnes

$$= 770 - 650 = 120$$

Hence, the correct answer is **120**.

1.45 (C)

Given :

- (i) 'relftaga' means carefree.
 (ii) 'otaga' means careful.
 (iii) 'fertaga' means careless.

Here, it is clear that 'taga' means care and if taga comes at the end in code language then meaning has 'care' at the front.

So, option (A) and (D) are incorrect.

In 'fertaga', 'fes' means less.

So, 'Tagafer' means less care.

Therefore, 'Tagazen' means aftercare.

Hence, the correct option is (C).

1.46 (B)

Elegance	Smooth	Soft	Executive
27300	20009	17602	9999
25222	19392	18445	8942
28976	22429	19544	10234
21012	18229	16595	10109
102510	80059	72186	39284
Rs. 48	Rs. 63	Rs. 78	Rs. 173
102510	80059	72186	39284
×48	×63	×78	×173
=4920480	=5043717	=5630508	=6796132

From the above table it is clear that, more revenue is obtained from executive.

Hence, the correct option is (B).

1.47 (A)

Given :

	Winner		Loses
P v/s Q	P	Always	Q
R v/s S	R	Always	S
S v/s P	P/S	Sometimes	P/S
R v/s Q	Q	Always	R

From the given data, it can be clearly inferred that P always beats Q . Since, Q always beats R ,

P can also beat R . P only sometimes beats S . Hence, P is likely to beat all the other three player. So, statement (i) can be logically inferred.

S only sometimes loses to P i.e. sometimes S wins as well, meaning S beats the best player sometimes. Hence, S can't be absolute worst player in the set.

So, statement (ii) can not be logically inferred.

Hence, the correct option is (A).

1.48 (C)

Given : $B, FH, LNP \dots$

Position of $B = 02$

$$B + 04 = 02 + 04 = 06(F)$$

Position of F and $H = 06$ and 08

$$H + 4 = 8 + 4 = 12(L)$$

Position of L, N and $P = 12, 14$ and 16

$$P + 4 = 16 + 4 = 20(T)$$

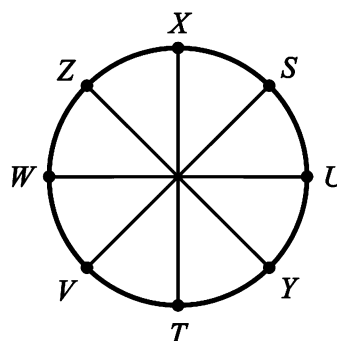
It is clear that alphabets in the series have single alphabet spacing between them. So,

T U V W X Y Z

Hence, the correct option is (C).

1.49 (A)

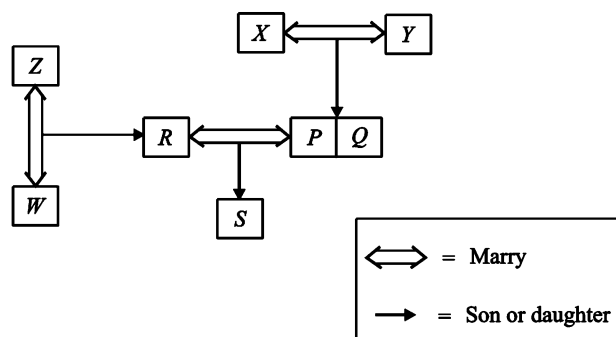
Following circular seating arrangement can be drawn



Only one such arrangement can be drawn. The person on third to the left of V is X .

Hence, the correct option is (A).

1.50 (B)



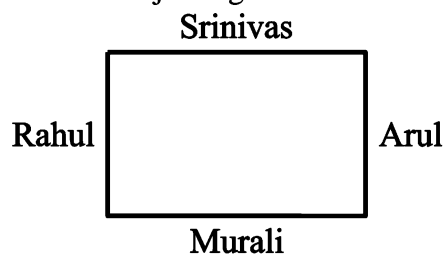
- (i) X is mother-in-law to R. Therefore option (A) is true.
- (ii) P and R can marry. Therefore option (B) is false.
- (iii) Q and R cannot marry. Therefore option (C) is true.
- (iv) P is son of X and Y. Therefore option (D) is true.

Hence, the correct option is (B).

1.51 (C)

Given :

- (i) Rahul, Murali, Srinivas and Arul are sitting around a square table.
- (ii) Rahul is just left to Murali.
- (iii) Srinivas is just right to Arul.



It can be concluded that Rahul is opposite to Arul and Srinivas is opposite to Murali.

Hence, the correct option is (C).

1.52 (B)

Given : All boxes have been labelled incorrectly. So,

Statement 1 : Box labelled “Apples” is either “Oranges” or “Apples and Oranges”.

Statement 2 : Box labelled “Oranges” is either “Apples” or “Apples and Oranges”.

Statement 3 : Box labelled “Apples and Oranges” is either “Apples” or “Oranges”.

After opening the box labelled “Apples and Oranges”, if we get Apple in it then it is sure that the box labelled “Apples and Oranges” is actually Apple.

So, Box labelled “Oranges” can have either only ‘oranges’ or ‘apples and oranges’. Since, all boxes are incorrectly labelled, box labelled as oranges can not have only oranges. Therefore, it must be having oranges and apple and box labelled “Apples” has to be “Oranges”.

Hence, the correct option is (B).

1.53 (C)

To verify the proposition the least number of cards that must be turned will be two.

- (i) Card with visible face of a colour.
- (ii) Card with visible face of a number.

Case 1 : Blue card and ‘2’ card :

If the blue card has number 2 on the other side then proposition is incorrect but if the other side has number 3 then next card has to be turned.

Now, if card ‘2’ has colour red on the other side then proposition is correct but if other side has colour blue then the proposition is wrong.

Case 2 : Red card and ‘3’ card :

If the red card has number 2 on the other side then we need a confirmation whether a number card has a red colour on the other side or blue colour. For that we must turn card ‘3’. If card ‘3’ has red colour on the other side then the proposition is wrong but if on the other side has blue colour then the proposition is correct.

Case - 2 does not match with any of the options.

Hence, the correct option is (C).

1.54 (D)

From the given graph it is clear that,

- (i) The halt at fourth floor is of 19 minutes over the period of one hour and at the ground floor the halt is of 21 minutes. So, statement (ii) is wrong.
- (ii) It is clear from the graph that the left moves directly from any non-ground floor to another non-ground floor over the one hour period multiple times such as,
- (a) At $t = 5$, from 1st to 5th floor
- (b) At $t = 10$, from 1st to 4th floor and so on.

So, statement (i) is also wrong.

Hence, the correct option is (D).

1.55 (B)

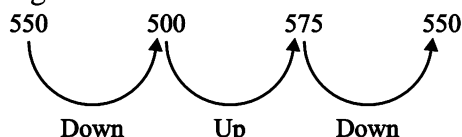
$$40\% \text{ of } 360^\circ = \frac{40}{100} \times 360^\circ = 144^\circ$$

So, the angle subtended on pie chart = 144° .

Hence, the correct option is (B).

1.56 (C)

Contour lines can be observed to cross region with height



Down-Up-Down satisfies.

Hence, the correct option is (C).

1.57 (D)

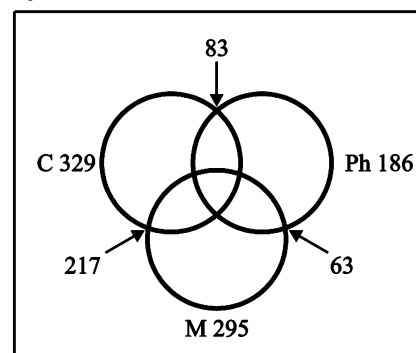
Given : The table below shows number of students taking respective subjects.

Subject	Number of students
Chemistry	329
Physics	186
Mathematics	295
Chemistry & Physics	83

Chemistry & Mathematics	217
Mathematics & Physics	63

This information is represented in a Venn diagram as given below,

(Assume x number of students are taking all the three subject.)



$$\begin{aligned}
 P(C \cup Ph \cup M) &= P(C) + P(Ph) \\
 &\quad + P(M) - P(C \cap Ph) - P(C \cap M) \\
 &\quad - P(Ph \cap M) + P(C \cap Ph \cap M) \\
 P(C \cup Ph \cup M) &= 329 + 186 + 295 \\
 &\quad - 83 - 63 - 217 + x \\
 P(C \cup Ph \cup M) &= 447 + x \quad \dots(i)
 \end{aligned}$$

Also, total number of students is 500.

$$\text{So, } P(C \cup Ph \cup M) = 500 \quad \dots(ii)$$

From equations (i) and (ii),

$$x = 500 - 447 = 53$$

Hence, the correct option is (D).

1.58 (B)

Given : P is 16 years old, Q is 25 years old, R is drinking milkshake and S is drinking beer.

Since, age of P is less than 18 year, so checking P 's drink and since S is drinking a beer so it is required to check age of S for the rule to be followed.

Also, since Q is 25 years old, he may have any drink and since R is drinking milk shake so there are no issues.

Therefore, P 's and S 's age should be checked to ensure that the rule is being followed.

Hence, the correct option is (B).

1.59 (B)

Given : Contour lines are plotted at a distance of 25 m.

Since, from figure it is clear that 'R' (425 m) is the only point which is very far from 'P'.

Steep path means a path which is rising or falling very rapidly.

$P \rightarrow R$ is a very narrow distance of about 150 m. Therefore, steepest path from 'P' is 'R'.

Hence, the correct option is (B).

1.60 (C)

It is given that contour lines are at 25 m interval in the given figure.

On calculating distance,

$$P = 575 \text{ m}$$

$$Q = 525 \text{ m}$$

$$R = 475 \text{ m}$$

$$S = 475 \text{ m}$$

$$T = 500 \text{ m}$$

Also, given that flood level rises to 525 m i.e. a village with a height less than 525 m will get submerged.

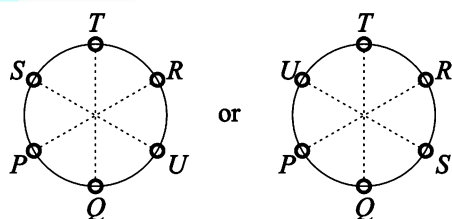
Thus, the villages which will be submerged if water level rises to 525 m are R, S and T.

Hence, the correct option is (C).

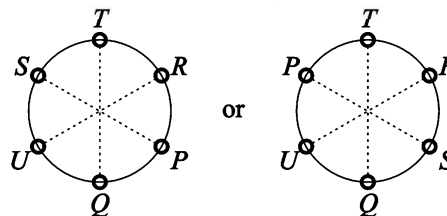
1.61 (C)

Most number of contours is passing through the region R. So, this region is most likely to have a thunderstorm.

Hence, the correct option is (C).

1.62 (C)

Now, P and U switch seats,

**Fig. (a)****Fig. (b)**

- (i) In both figure, P is not immediately to the right of R.
- (ii) In figure (a), T is not immediately to the left of P.
- (iii) In figure (a), P is immediately to the right of Q.
In figure (b), T is immediately to the left of P.
- (iv) In both figure, U is not immediately to right of R and P is not immediately to the left of T.

Hence, the correct option is (C).

1.63 (B)

Given table is shown below,

Names	Student seniority	Current room	Room preference list
Amar	1	P	R, S, Q
Akbar	2	None	R, S
Anthony	3	Q	P
Ajit	4	S	Q, P, R

Amar is the most senior student and his first preference is room R. So, he will move to room R. Akbar is second in the seniority list. Since, R is allotted to Amar, Akbar will get room S. Next in line is Anthony, who will move to room P. So, Ajit will get room Q.

Hence, the correct option is (B).

1.64 (C)

Given figure is shown below,

- (i) Number of beds made by carpenter C2
 $= 20 - 12 = 8$

Number of tables made by carpenter C3
 $= 13 - 5 = 8$

So, statement (i) is true.

- (ii) Total number of chairs made by all components
 $= C1 + C2 + C3 + C4 + C5$
 $= 2 + 10 + 5 + 2 + 4$
 $= 23$

Total number of tables made by all carpenters
 $= C1 + C2 + C3 + C4 + C5$
 $= 7 + 2 + 8 + 3 + 10$
 $= 30$

So, statement (ii) is also true.

Hence, the correct option is (C).

1.65 (A)

Given :

- (i) P states that S has at least 3 cars
 i.e. $S \geq 3 \Rightarrow S = 3, 4, \dots$
- (ii) Q believes that S has less than 3 cars
 i.e. $S < 3 \Rightarrow S = 0, 1, 2$
- (iii) R believes that S has at least 1 car
 i.e. $S \geq 1 \Rightarrow S = 1, 2, 3, \dots$
- (iv) Only one of P , Q and R is right

If we assume P is right then S can have 4, 5, 6, ... cars but not 3 because then R will be right as well but only one of them can be right. But 4, 5, 6, ... are not given in the options.

If we assume Q is right then S will have 0 cars because $S = 1, 2$ is also present in R .

If we assume R is right then P and Q will be right as well.

Therefore, the number of cars owned by S is 0.

Hence, the correct option is (A).

1.66 (A)

Given : Minimum bacterial population density of 0.8 is needed to form curd.

According to the given graph,

- (i) Growth in bacterial population stops at 150 min. at 37°C and for 25°C , it stops at 180 min.
 So, statement (i) is true.
- (ii) The time taken for curd formation at 25°C is a little more than 120 min. At 37°C , it is 90 min.

So, statement (ii) is not true.

Hence, the correct option is (A).

1.67 (D)

Given :

- (i) P looks at Q and Q looks at R .
- (ii) P is married and R is unmarried.

Since, the marital status of Q is unknown, it can not be determined that how many pairs of people in which a married person is looking at an unmarried person.

Hence, the correct option is (D).

1.68 (B)

Given plot is shown below,

According to the above plot,

- (i) In winter, the difference between maximum and minimum pollutant concentration
 $= 8 - 0 = 8$

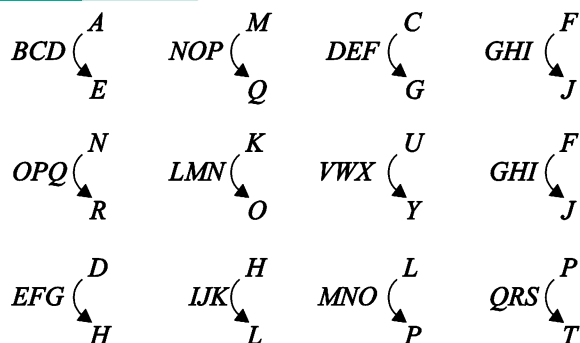
In summer, the difference between maximum and minimum pollutant concentration
 $= 10.5 - 1.5 = 9$

So, statement (i) is incorrect.

- (ii) Between 10th day and 14th day (4 days) in the summer month, the pollutant concentrations on the corresponding days in the winter month.

So, statement (ii) is correct.

Hence, the correct option is (B).

1.69 (C)

Hence, the correct option is (C).

1.70 (C)

P has to row on return journey as he can not row with anyone else. On next trip *P* will be leaving *R* and *R* will row. After this *R* will return back to pickup *Q* so on the last trip *Q* and *R* will go together in which *Q* will be rowing the boat. Therefore, *R* will be rowing the boat twice.

Hence, the correct option is (C).

1.71 (A)

From the above graph, it is clear that during the period 2002 to 2004, there was relatively no crow birth and cracker sales also remained flat during the same.

From 2004 to 2005, there was a sudden spike in crow birth as well as cracker sales.

In 2006 crow birth and sales of crackers decrease simultaneously.

Therefore, it can be said that there is strong correlation between crow birth and cracker sales. Increase or decrease in sales of crackers does not affect the increase or decrease in birth of crows.

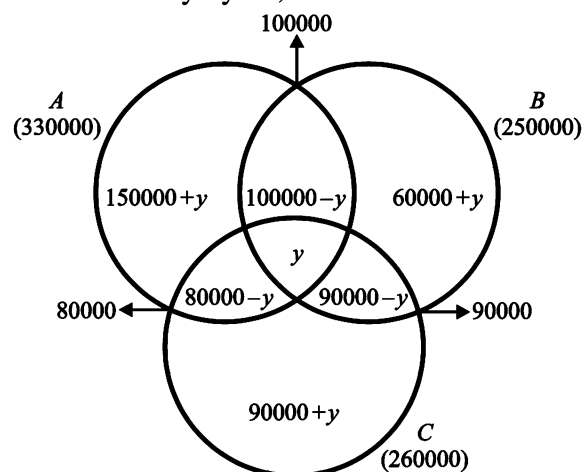
Hence, the correct option is (A).

1.72 (D)

Given :

- (i) Total number of candidates appeared = 6,30,000
- (ii) Question A was answered correctly by 3,30,000 candidates.

- (iii) Question B was answered correctly by 2,50,000 candidates
- (iv) Question C was answered correctly by 2,60,000 candidates.
- (v) Both questions A and B were answered correctly by 1,00,000 candidates.
- (vi) Both questions B and C were answered correctly by 90,000 candidates.
- (vii) Both questions A and C were answered correctly by 80,000 candidates.



y = Total number of candidates attempted all questions correctly.

Number of students answering all questions correctly = Number of students answering zero questions correctly = y

According to question,

Total number of candidates

= Number of candidates with only one correct answer + With only two correct answers + With all correct answers + No correct answers.

$$630000 = (150000 + y + 60000 + y + 90000 + y) + (100000 - y + 80000 - y + 90000 - y) + y + y$$

$$630000 = 2y + 150000 + 100000 + 80000 + 60000 + 90000 + 90000$$

$$630000 - 570000 = 2y$$

$$y = 30000$$

The students failed to clear the test = Number of students answered only one question correctly + Number of students answered zero questions correctly

$$\begin{aligned} &= (150000 + y + 60000 + y + 90000 + y) + y \\ &= 150000 + 60000 + 90000 + 4y \\ &= 300000 + 4 \times 30000 = 420000 \end{aligned}$$

Hence, the correct option is (D).

1.73 (B)

Given : $T = K(\theta_p + T_0)$

Table is shown below,

T_0	p	T
25	2	32.4
30	5	42.0

According to the given data,

$$32.4 = K(\theta \times 2 + 25) \quad \dots (i)$$

$$42 = K(\theta \times 5 + 30) \quad \dots (ii)$$

From equation (i) and (ii),

$$\frac{42}{32.4} = \frac{5\theta + 30}{2\theta + 25}$$

$$84\theta + 1050 = 162\theta + 972$$

$$78\theta = 78$$

$$\theta = 1$$

Hence, the correct option is (B).

1.74 (B)

Prime factorization of digit 1 to 9 can be written as,

$$\begin{aligned} 1 &= 1 & 2 &= 2 \\ 3 &= 3 & 4 &= 2 \times 2 \\ 5 &= 5 & 6 &= 3 \times 2 \\ 7 &= 7 & 8 &= 2 \times 2 \times 2 \\ 9 &= 3 \times 3 \end{aligned}$$

If $A \times G \times E = B \times G \times E = D \times E \times F$

Will be equal only when prime factorization of all 3 term should be equal.

But in between 1 to 9 we can observe that 5 and 7 are not present as a prime factor of any term.

To become 5 and 7 as a part of these multiplication there should be a common alphabet, but we can observe there is no any alphabet common in these three.

Therefore, 5 and 7 can't be as a part of these multiplication.

Since, 7 is not present in option.

So, 5 will be correct option.

Hence, the correct option is (B).

1.75 (B)

Given :

(i) Each of the letters represent a unique integer from 1 to 9.

$$\text{So, } A + B + C + \dots + K = 45 \quad \dots (i)$$

$$(ii) \quad A + B + C = 13 \quad \dots (ii)$$

$$C + D + E = 13 \quad \dots (iii)$$

$$E + F + G = 13 \quad \dots (iv)$$

$$G + H + K = 13 \quad \dots (v)$$

Adding all four equation,

$$A + B + 2C + D + 2E + F + 2G + H + K = 52$$

From equation (i),

$$C + E + G = 52 - 45$$

$$C + E + G = 7 \quad \dots (vi)$$

and $E + F + G = 13$

From option (A),

$$E = 1$$

Then, $C + G = 6$

and $F + G = 12$

Now, C and G should be less than 6.

Since, $E = 1$, $C \neq 1$

So, $C = 2$, $G = 4$ or $C = 4$, $G = 2$

When $C = 2$ and $E = 1$, then D has to be 10 for the sum 13 which is not possible.

When $C = 4$ and $G = 2$, then F has to be 10, which is also not possible.

Hence, option (A) is incorrect.

From option (B),

$$E = 4$$

Then, $C + G = 3$ and $F + G = 9$

Now, C and G should be less than 3.

Let $C = 1, G = 2$ or $C = 2, G = 1$

When $C = 1, G = 2 \Rightarrow F = 7$ [Possible]

$$C + D + E = 13$$

$$1 + D + 4 = 13$$

$$D = 8$$

So, $C = 1, D = 8, E = 4, F = 7, G = 2$

Now, $A + B + C = 13$

So, $A = 9, B = 3$ or $A = 3, B = 9$

$$G + H + K = 13$$

So, $H = 6, K = 5$ or $H = 5, K = 6$

It is clear that every alphabet has unique number.

Hence, the correct option is (B).

1.76 (C)

Given : Annual average rainfall = 1000 mm

Rainfall falling on a rooftop = 50%

Obstruction-free area = 50 m^2

Cumulative rainfall (from the graph) = 300 mm

50% of the cumulative rainfall

$$= \frac{50}{100} \times 300 = 150 \text{ mm} = 150 \times 10^{-3} \text{ m}$$

Total volume of water collected in the tank =
Obstruction-free area $\times$ 50% of cumulative rainfall

Total volume of water collected in the tank
 $= 50 \times 150 \times 10^{-3} = 7.5 \text{ m}^3 = 7500 \text{ liters}$

Hence, the correct option is (C).

1.77 (D)

Given :

A house has a number which needs to be identified, using 3 given conditions.

According to statement (i) :

Possible numbers are $\rightarrow 51, 54, 57$

According to statement (ii) :

Possible numbers are

$\rightarrow 61, 62, 63, 65, 66, 67, 69$

According to statement (iii) :

Possible numbers are

$\rightarrow 70, 71, 73, 74, 75, 76, 77, 79$

From option (A) : 54 is a multiple of 3 and it is a number from 50 to 59 [first condition satisfied]. 54 is not a multiple of 4 but it does not belong to the range 60-69. Therefore, it is incorrect.

From option (B) : Condition 1 can not be applied for 65. 65 is not a multiple of 4 and belongs to range 60-69 [Second condition satisfied]. Also, 65 is not a multiple of 6 but it does not belong to the range 70-79. Therefore, it is also incorrect.

From option (C) : 66 is a multiple of a 3 but does not belong to the range 50 – 59 . Therefore it is incorrect

From option (D) : Condition (i) and (ii) can not be applied here because 76 is not a multiple of 3 but it is a multiple of 4. 76 though, it is not a multiple of 6 and belongs to the range 70-79 [Third condition satisfied]

Hence, the correct option is (D).

1.78 (B)

Given : $E = 10, J = 20, O = 30, T = 40$

Here, $E = 2 \times \text{Position of } E (5^{\text{th}}) = 10$

$J = 2 \times \text{Position of } J (10^{\text{th}}) = 20$ and so on.

Therefore, $P = 2 \times \text{Position of } P (16^{\text{th}}) = 32$

$S = 2 \times \text{Position of } S (19^{\text{th}}) = 38$

So, $P + E + S + T = 32 + 10 + 38 + 40 = 120$

Hence, the correct option is (B).

1.79 (D)

Given :

(i) Q is wife of P .

(ii) R is child of P and T is child of S .

Since, T is child of S , S can not be aunt of T

Hence, the correct option is (D).

1.80 (B)**Given :**

- (i) No pair should work for more than 5 hours.
- (ii) Ram and John have worked together for 5 hours.
- (iii) Krishna and Amir have worked as a team for 2 hours.
- (iv) Krishna does not want to work with Ram. John can not work with Ram anymore since his 5 hours have been completed with Ram. Now, John can either work with Krishna or Amir. If John works with Amir, Krishna will have to work with Ram but since it is clearly mentioned that Krishna does not want to work with Ram, Krishna has to work with John and Amir will then work with Ram for all workers to continue working.

Hence, the correct option is (B).

1.81 (B)**Given :**

- (i) Out of four criminals P , Q , R and S , only one committed the crime
 - (ii) Only one criminal is telling the truth.
- If P is telling the truth then Q and R both committed the crime which is not possible.
- If Q is telling the truth then S and R both committed the crime which is again not possible.
- If R is telling the truth then Q and S will contradict each other.
- If S is telling the truth only R committed the crime.

Hence, the correct option is (B).

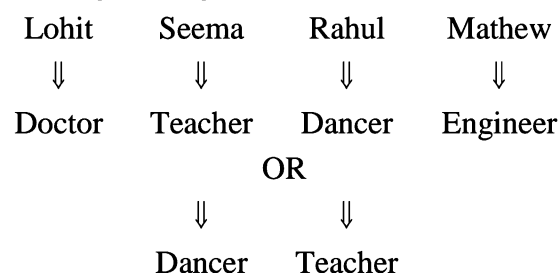
1.82 (D)

According to given data, Z believes in vastu and wants to stay in the south-west wing. In all the given options, Only option (D) satisfies this request.

Hence, the correct option is (D).

1.83 (D)

According to the given data,



According to the given statements, the positions with profession of different peoples are shown above.

Only Mathew can be the engineer and Lohit can be the doctor, Seema and Rahul are teacher and dancer but we cannot surely tell about them.

Hence, the correct option is (D).

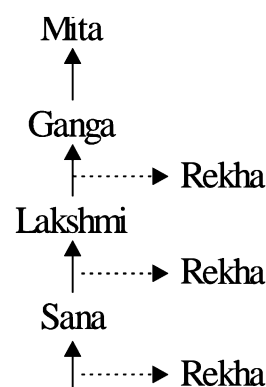
1.84 (A)

It is given that P and Q share the same office, R and T share the same office and S is in the adjacent office of R . Only option (A) satisfies the given conditions.

Hence, the correct option is (A).

1.85 (A)

From the given information, we can draw as follows

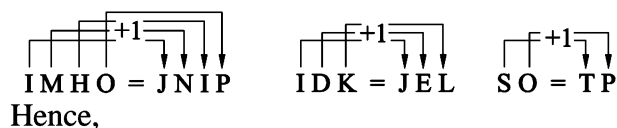


There is no clear information about height of Rekha except that Rekha is shorter than Mita and Ganga. Sana is shorter than Mita, Ganga and Lakshmi.

Hence, the correct option is (A).

1.86 (B)

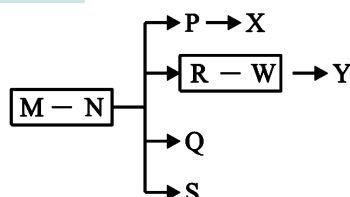
Given :



IDC = JED

Hence, the correct option is (B).

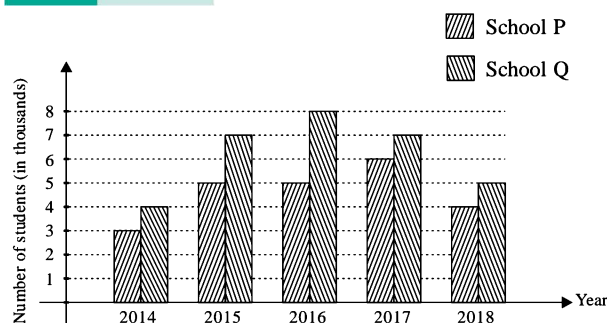
1.87 (A)



Since, only P and R married and the both have child X and Y respectively whereas Y is also child of W. So, there is no relation between P and W i.e. W can't be wife of P.

Hence, the correct option is (A).

1.88 (B)



Average students enrolled in

$$P = \frac{3+5+5+6+4}{5} = \frac{23}{5}$$

Average of difference of students enrolled in school

$$P \text{ and } Q = \frac{2+1+3+1+1}{5} = \frac{8}{5}$$

Ratio of average students enrolled in school P to the ratio of average of difference of students enrolled in school P and Q

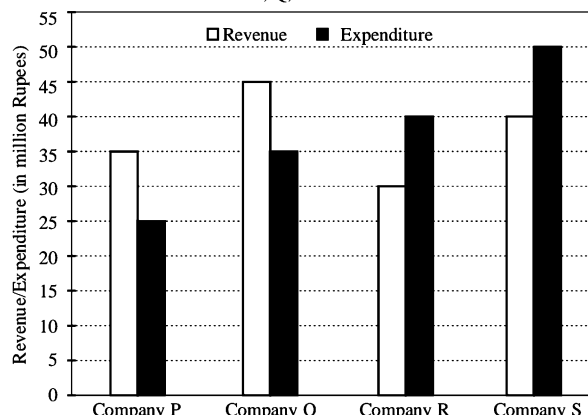
$$= \frac{23/5}{8/5} = 23:8$$

Hence, the correct option is (B).

1.89 (A)

Given : Bar chart showing line revenue and expenditure of four companies P, Q, R & S is shown in figure,

Revenue and Expenditure (in million Rupees) of four companies P, Q, R and S in 2015



Revenue of company Q in 2015 = 45 million

Given that it is 20% more than that in 2014.

Let revenue of Q in 2014 is x million

Then, $x + x \times \frac{20}{100} = 45$

$$\Rightarrow x + \frac{x}{5} = 45$$

$$\Rightarrow 6x = 45 \times 5$$

$$x = 37.5 \text{ million}$$

$$(\text{Expenditure}) + \left(\text{Expenditure} \times \frac{10}{100} \right) = 37.5$$

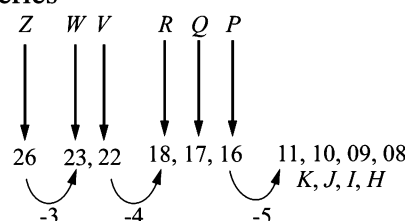
$$\Rightarrow \frac{11}{10} \times \text{Expenditure} = 37.5$$

$$\therefore \text{Expenditure} = \frac{37.5}{1.1} = 34.09 \approx 34.1$$

Hence, the correct option is (A).

1.90 (B)

Given series



Hence, the correct option is (B)

1.91 (A)

Since, it is asked in the question that P, Q, R and S are to be uniquely coded.

According to question,

$$P \rightarrow \alpha\alpha$$

$$Q \rightarrow \alpha\beta$$

Therefore, by observation option (B), (C) and (D) are eliminated.

Hence, the correct option is (A)

1.92 (C)

According to question :

$$1^{\text{st}} \text{ case pass \%} = \frac{280}{500} \times 100 = 56$$

$$2^{\text{nd}} \text{ case pass \%} = \frac{330}{600} \times 100 = 55$$

$$3^{\text{rd}} \text{ case pass \%} = \frac{455}{700} \times 100 = 65$$

$$4^{\text{th}} \text{ case pass \%} = \frac{240}{400} \times 100 = 60$$

Total average passing percentage of students

$$= \frac{56 + 55 + 65 + 60}{4} = 59.0\%$$

Hence, the correct option is (C).

1.93 (B)

According to question,

$$XY \propto Z$$

$$XY = KZ$$

By the observation from above equation, statement of option (B) is false.

Hence, the correct option is (B)

1.94 (D)

Ratio of boys enrolled in arts to the girls enrolled in management

$$= \frac{\text{Total students in art} - \text{Girls in art}}{\text{Girls in management}}$$

$$= \frac{5000 \times 0.20 - 1500 \times 0.30}{1500 \times 0.15} = 22 : 9$$

Hence, the correct option is (D)

1.95 (B)

0, 1, 2, 3, 4, 5, 6, 7, 8, 9
O, P, Q, R, S, T, U, V, W, X

4, 5 will be coded as S, T.

Hence, the correct option is (B).

1.96 (B)

The amount spent on transportation is 10%

The amount spent on education is 15 %

The extra amount spent on education compared to transportation

$$= \frac{15 - 10}{10} \times 100 = 50\%$$

Hence, the correct option is (B).

1.97 (A)

Given statement : P, Q and T refuses to sleep next to R.

$\therefore$ Options (B), (C) and (D) are incorrect.

Only option (A) follows the given condition.

Hence, the correct option is (A)

1.98 (C)

Given statement : 'P' wanted a room adjacent to the bas

Therefore option (A) is incorrect.

The statement 'Q wanted to be close to the lift'

Therefore, option (B) is incorrect.

The statement 'S wanted a corner office'

Therefore, option (D) is incorrect.

Only option (C) satisfies all the statements.

Hence, the correct option is (C).

1.99 (B)

From the given pie chart and corresponding table

Month	X : Y	Sales (X + Y)	X	Y
April	3 : 2	15%	9%	6%
May	1 : 4	10%	2%	8%
June	9 : 11	10%	4.5%	5.5%

Total LED bulbs = 50000

The number of LED bulbs sold by the firm Y during April - June 2018 is given by,

$$Y = 19.5\% \text{ of } 50000$$

$$Y = \frac{19.5}{100} \times 50000 = 9750$$

Hence, the correct option is (B).

1.100 (A)

Under high inflation, the real interest rate would be low, hence it is the borrowers and not the lenders who get benefited.

Hence, the correct option is (A).

1.101 (C)

Given : $P = 3$, $R = 27$, $T = 243$

The series of consecutive letters are

P, Q, R, S and T

$$\text{Now, } P = 3^1, Q = 3^2, R = 3^3, S = 3^4, T = 3^5$$

$$\text{i.e., } Q + S = 3^2 + 3^4 = 9 + 81 = 90$$

Hence, the correct option is (C).

1.102 (A)

The total expenditure of the company during 2014 to 2018 = $500 \times 5 = \text{Rs. } 2000$ millions

Total revenue of the company during 2014 to 2018 = $500 + 700 + 800 + 600 + 400 = \text{Rs. } 3000$ millions

$$\text{So, profit \%} = \frac{3000 - 2500}{2500} \times 100 = 20\%$$

Hence, the correct option is (A).

1.103 (B)

Basic concept : Revenue = Profit + Investment

According to the question, a basic amount is invested by the two companies, let it be 100 and the profit of both the companies is given in the graph.

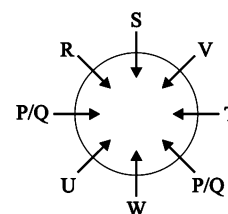
So according to the graph,

$$\begin{aligned} \frac{\text{Total revenue of company P}}{\text{Total revenue of company Q}} &= ? \\ &= \frac{(100 + 10) + (100 + 20) + (100 + 40) + (100 + 40) + (100 + 50) + (100 + 40)}{(100 + 20) + (100 + 30) + (100 + 30) + (100 + 50) + (100 + 60) + (100 + 60)} \\ &= 16:17 \end{aligned}$$

Hence, the correct option is (B)

1.104 (A)

The seating arrangement of P, Q, R, S, T, U, V and W around a circular table can be as follows :



So, the statement which must be true is P is not seated opposite to Q.

Hence, the correct option is (A).

1.105 (D)

Given :

According to the data in the question we can form the table as shown below,

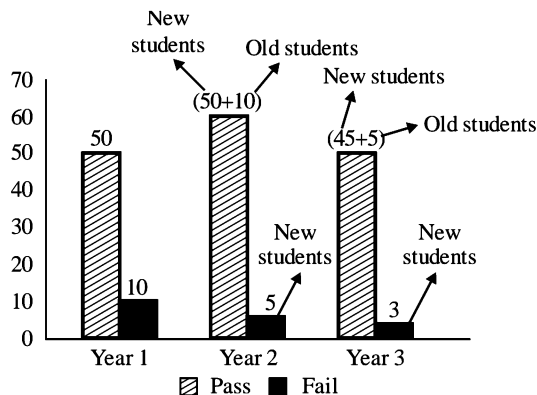
Days	Y	X	% more than the other students
Sunday	65	55	$\frac{65 - 55}{55} \times 100\% = 18.18\%$
Saturday	50	60	$\frac{60 - 50}{50} \times 100\% = 20\%$
Friday	35	20	$\frac{35 - 20}{20} \times 100\% = 75\%$
Thursday	55	60	$\frac{60 - 55}{55} \times 100\% = 9.09\%$
Wednesday	50	60	$\frac{60 - 50}{50} \times 100\% = 20\%$
Tuesday	65	55	$\frac{65 - 55}{55} \times 100\% = 18.18\%$
Monday	70	45	$\frac{70 - 45}{45} \times 100\% = 55.55\%$

Except Thursday, there are total 6 days in which one of the students spent a minimum of 10% more than the other student.

Hence, the correct option is (D).

1.106 (C)

Given :



The number of students who took exam for 1st time in year 2nd is,

$$50 + 5 = 55$$

The number of students who took exam for 1st time in year 3rd is,

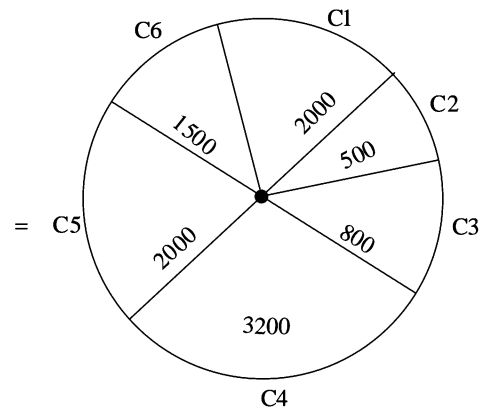
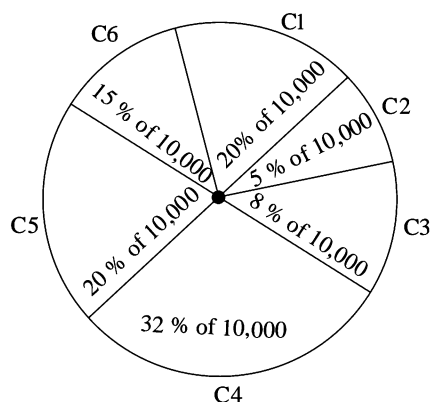
$$45 + 3 = 48$$

Thus, the number of students who took the exam for the first time in the year 2nd and in the year 3rd respectively are 55 and 48.

Hence, the correct option is (C).

1.107 (C)

Given : Total number of employees = 10000



According to the question,

The ratio of executives with a management degree to those without a management degree in company C2 and C5 are 1 : 4 and 9 : 1 respectively,

Therefore number of executives with management degree in C2 is, $500 \times \frac{1}{5} = 100$

And number of executives with management degree in C5 is, $2000 \times \frac{9}{10} = 1800$

Thus, the total number of management degree holders among the executives in companies C2 and C5 together is, $100 + 1800 = 1900$

Hence, the correct option is (C).

1.108 (D)

Given :

Cost per unit of year 3 = Rs.1

and Cost per unit of year 3

$$= \frac{\text{Cost per unit of year 2}}{2}$$

So, cost per unit of year 2

$$= 2 \times \text{Cost per unit of year 3}$$

$$= 2 \times 1 = 2.$$

Let, Selling price of year 2 = SP2 and

Selling price of year 3 = SP3.

We have taxes in year 2 and year 3 as 13% and 15% of selling price respectively.

$$\text{So, Tax in year 2} = 13 \times \frac{\text{SP2}}{100} = 0.13 \times \text{SP2}$$

$$\text{Tax in year 3} = 15 \times \frac{\text{SP3}}{100} = 0.15 \times \text{SP3}$$

Profit in year 2 = Selling price in year 2 – (cost of all units + tax in year 2)

$$296 = \text{SP2} - (200 \times 2 + 0.13 \times \text{SP2})$$

$$296 = \text{SP2} - 400 - 0.13 \text{ SP2}$$

$$296 + 400 = 0.87 \times \text{SP2}$$

$$696 \times \frac{100}{87} = \text{SP2}$$

SP2 = 800.

Profit in year 3 = Selling price in year 3 – (cost of all units + tax in year 3)

$$210 = \text{SP3} - (300 \times 1 + 0.15 \times \text{SP3})$$

$$210 = SP3 - 300 - 0.15 \times SP3$$

$$210 + 300 = 0.85 \times \text{SP3}$$

$$510 \times \frac{100}{85} = \text{SP3}$$

SP3 = 600

So, ratio of Selling Price in year 2 to Selling Price in year 3

$$= \frac{800}{600} = \frac{4}{3}$$

Hence, the correct option is (D).

1.109 (B)

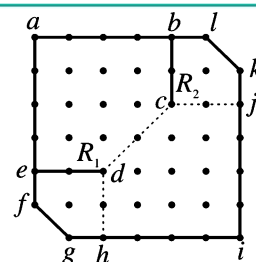
Given :

A plot of land must be divided between four families.

Divided plots should be similar in shape not necessarily in area.

Two ropes R_1 and R_2 are already present in the plot and cannot be moved.

A straight rope can pass through three poles that are in a straight line.



In the figure shown above we can clearly see the least number of additional straight ropes shown by dotted line needed to divided plot in four parts.

The plots are abcde, bcjkl, cdhij and efghd.

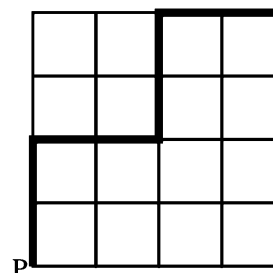
Which are same in shape but not in size.

Hence, the correct option is (B).

1.110 (B)

Given :

An ant is at the bottom left corner of a grid (point p)



Ant aims to move to the top right corner of the grid.

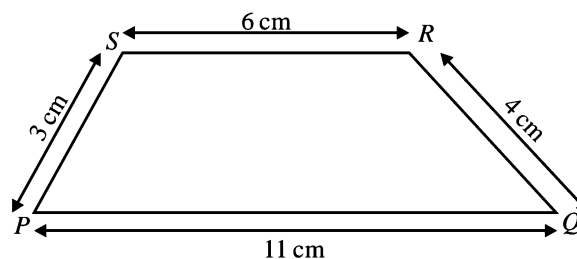
If the ant moves only along the lines marked in the grid so that the current distance to the top right corner strictly decreases.

Ant has to move according to the path given in option (B).

Hence, the correct option is (B).

1.111 (D)

Given :



There is a Trapezium $PQRS$,

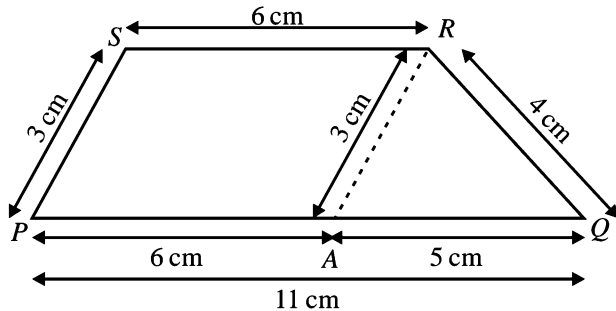
Length of $PQ = 11$ cm

Length of $QR = 4$ cm

Length of $PS = 3$ cm

Length of $RS = 6$ cm

Let us consider, a line segment RA which is parallel to PS .



Now, Length of side $AQ = 5$ cm

$PA \parallel SR$, $PS \parallel AR$

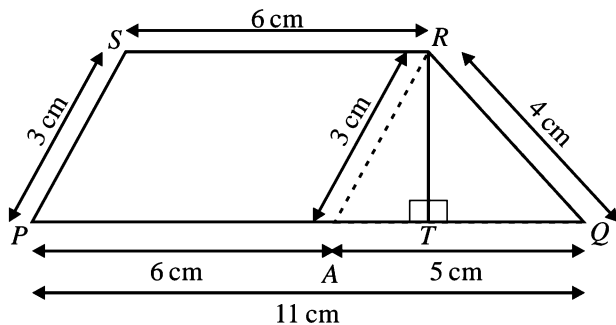
So, Length of side $AR = 3$ cm

Length of side $RQ = 4$ cm

Length of side $AQ = 5$ cm

(Sides of $\triangle ARQ$ follows the property of Pythagoras theorem)

Let us consider a perpendicular RT which is shortest path of PQ and RS



Area of Triangle = $\frac{1}{2} (\text{Base} \times \text{Height})$

Area of $\triangle ARQ = \frac{1}{2} \times 3 \times 4$ sq. cm

and also, Area of $\triangle ARQ = \frac{1}{2} \times AQ \times RT$

$$\frac{1}{2} \times AQ \times RT = \frac{1}{2} \times 3 \times 4 \text{ sq. cm}$$

$$AQ \times RT = 12 \text{ sq. cm}$$

$$5 \text{ cm} \times RT = 12 \text{ sq. cm}$$

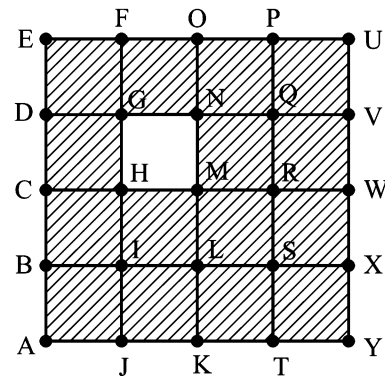
$$RT = 2.4 \text{ cm}$$

Hence, the correct option is (D).

1.112 (D)

Given : The figure shows a grid formed by a collection of the unit square. The unshaded unit square in the grid represents a hole.

The maximum number of square without a “hole in the interior” that can be formed within the 4×4 grid can be counted as.



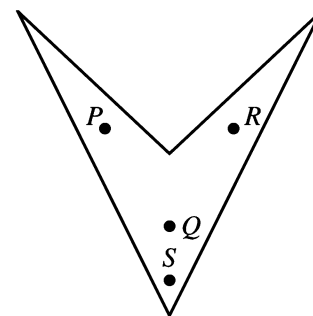
(ABIJ, BCHI, CDGH, DEFG, FONG, HMLI, ILKJ, KLST, LMRS, MNQR, NOPQ, PUVQ, QVWR, RWSX, SXYT, ACMK, JHRT, KMWY, LNVX, MOUW)

Total number of squares are 20.

Hence, the correct option is (D).

1.113 (B)

Given : The diagram below represents the plan of the gallery where the boundary wall are opaque.



The art gallery engages a security guard to ensure that the items displayed are protected.

The location where the security guard posted is identified such that all the inner space of the gallery is within the line of sight of the security guard.

The condition is if the security guard does not move around the posted location and has 360° view,

The set of all possible location among the locations P, Q, R and S are Q and S from where the security guard can be posted to watch over the entire inner space of the gallery

Hence, the current option is (B).

1.114 (C)

Given : A square with the four corners and the center marked as P, Q, R, S and T respectively and XYZ represent following operation.

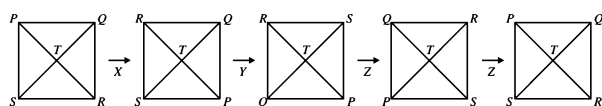
X : Rotation of the square by 180 degree with respect to the S-Q axis

Y : Rotation of the square by 180 degree with respect to the P-R axis

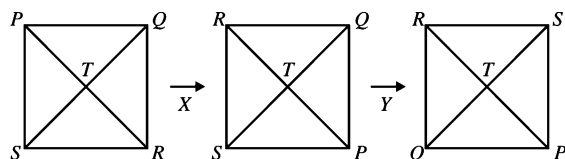
Z : Rotation of the square by 90 degree clockwise with respect to the axis perpendicular going into the screen and passing through the point T.

Following three distinct sequences of operation are as follows.

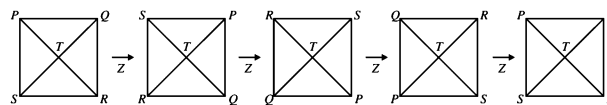
1. XYZZ : $X \rightarrow Y \rightarrow Z \rightarrow Z$



2. XY

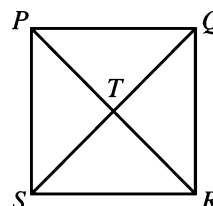


3. ZZZZ

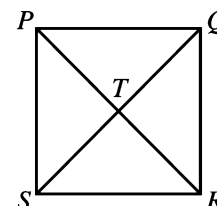


As per the information and operations sequence of operation 1 and 3 are equivalent.

1. XYZZ



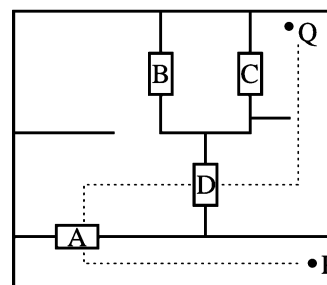
3. ZZZZ



Hence, the correct option is (C).

1.115 (C)

Given : A building has several rooms and doors as shown in the top view of the building given below



A, B, C, D are doors.

The minimum number of doors that need to be opened in order to go from the point P to the point Q are two.

As path shown by dotted line from P to Q we only need to open door A and D.

Hence, the correct option is (C).

1.116 (D)

Given : A game consists of spinning an arrow around a stationary disc.

When the arrow comes to rest, there are eight equally likely outcomes that means the probability of getting only one number out of 1, 2, 3, 4, 5, 6, 7 and 8 is $\frac{1}{8}$.

$P(\text{Event}) = P(\text{getting number from disc one}).$

$P(\text{getting number from disc two})$

As they are independent spins $\frac{1}{8} \times \frac{1}{8} = \frac{1}{64}$

We need to calculate the sum of 8 from both the discs, so the possible outcomes are

(1, 7), (2, 6), (3, 5), (4, 4), (5, 3), (6, 2), (7, 1)

Here we have seven favorable out comes.

$$P(E) = \frac{7}{64}$$

Hence, the correct option is (D).

1.117 (A)

Given : $3p - q < 4$... (i)

$3q - p < 12$... (ii)

From equation (i) and (ii) we get,

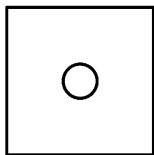
$$2q + 2p < 16$$

$$p + q < 8$$

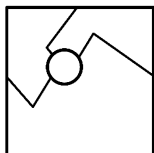
Hence, the correct option is (A).

1.118 (C)

After assembling the given set of pieces to form a square with a single round hole near the center the figure should be look like the figure given below,



Therefore, by assembling the given set of pieces of option (C), we get



Hence, the correct option is (C).

1.119 (B)

Given : P is the sister of Q

Q is the husband of R

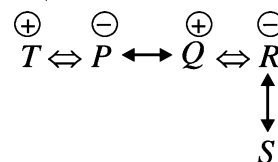
R is the mother of S

T is the husband of P

Family Tree diagram can be made as :

Here, $\oplus$: Male, $\ominus$: Female, $\leftrightarrow$: Spouse, $\longleftrightarrow$

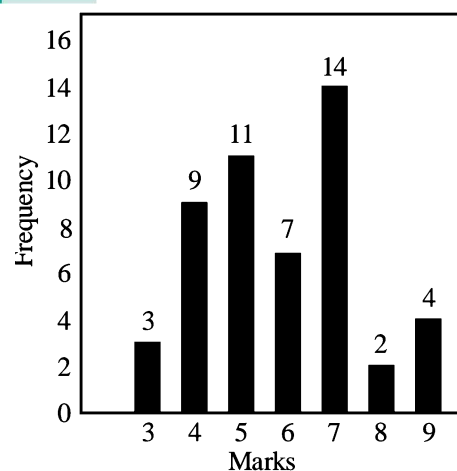
Siblings, $\updownarrow$: Generation gap.



According to the family tree diagram T is an uncle of S.

Hence, the correct option is (B).

1.120 (D)



According to above chart, clearly mode is 7 marks as mode is the mark whose frequency is highest

$$\text{Mean} = \frac{\text{Total marks}}{\text{Total students}}$$

$$\text{Mean} = \frac{(3 \times 3) + (4 \times 9) + (5 \times 11) + (6 \times 7) + (7 \times 14) + (8 \times 2) + (9 \times 2)}{(3 + 9 + 11 + 7 + 14 + 2 + 4)}$$

$$\text{Mean} = \frac{292}{50} = 5.84$$

We know, Mode = 3 median - 2 mean

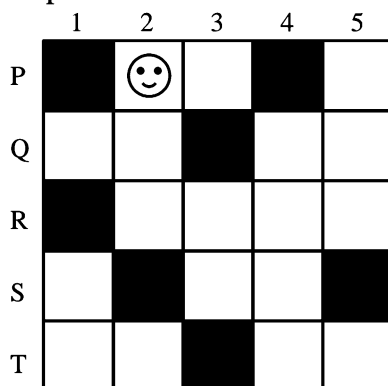
$$\text{So, } 7 = 3 \text{ median} - 2 \times 5.84$$

$$\frac{7 + 11.68}{3} = \text{Median} = 6.72 \text{ median}$$

$$\therefore \text{Mode} > \text{Median} > \text{Mean}$$

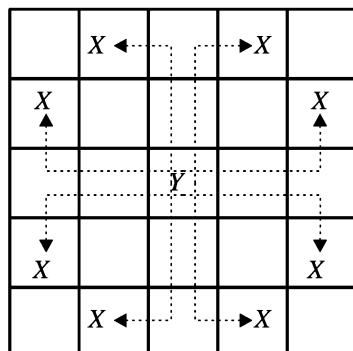
1.121 (B)**Given :**

A person standing at P2 position is required to move to P5 position.

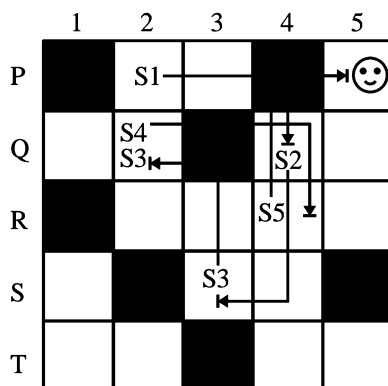


The condition is, the only movement for a step involves, “two moves along one direction followed by one move in a perpendicular direction”.

According to the permissible direction for movement are shown as dotted arrows in diagram given below.



The minimum number of steps required to go from P2 to P5 are followed as



Step 1 : P2 → P3 → P4 → Q4

Step 2 : Q4 → R4 → S4 → S3

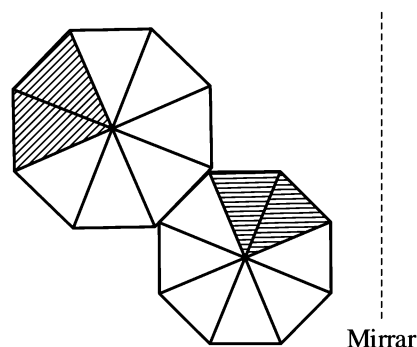
Step 3 : S3 → R3 → Q3 → Q2

Step 4 : Q2 → Q3 → Q4 → R4

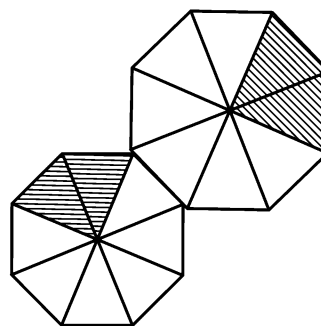
Step 5 : R4 → Q4 → P4 → P5

So we need minimum 5 steps according to the given conditions to reach P5 from P2.

Hence, the correct option is (B).

1.122 (D)

As the mirror is placed on the right side of figure, The reflection will be shown as



Option (D).

1.123 (B)**Given :** Girl P is learning French and Dutch

Girl Q is learning Chinese and Japanese

Girl R is learning Spanish and French

Girl S is learning Dutch and Japanese

French is easier than Dutch;

French < Dutch ... (i)

Chinese is harder than Japanese;

Chinese > Japanese ... (ii)

Dutch is easier than Japanese;

Japanese > Dutch ... (iii)

Spanish is easier than French;

French > Spanish ... (iv)

By equation (i), (ii), (iii) and (iv)

Chinese > Japanese > Dutch > French > Spanish according to the difficulty level arrangement

Girl Q is learning most difficult pair of languages, which is Chinese and Japanese.

Hence, the correct option is (B).

1.124 (A)

Given : We can combine the convex lens and the concave lens and the combined lens is called a convexo-concave or concavo-convex lens for which one side is convex and other side is concave. Since, convex and concave lenses are 3-dimensional object because each one is formed from two spheres (a three-dimensional object) and so the combined object is also a 3-dimensional object.

Hence, (B) and (C) are eliminated and (A) is correct.

Now, option (D), if you consider the edge as a straight line then for a finite three-dimensional object, option (D) is wrong because where at least two lines or straight edges meet, it creates a corner and according to the definition of smoothness, it should not have a sudden rise or fall and so it will not be a smooth object and so if edge means straight edges.

Hence, the correct option is (A).

1.125 (A)

Given : Universities $U = 504$

Collages $C = 25951$

Total $(U + C) = 504 + 25951 = 26455$

For grade 3 collage and university

$$G_3(U) = \frac{7}{100} \times 504 = 35.28$$

$$G_3(C) = \frac{23}{100} \times 2595 = 5968.73$$

$$G_3(U + C) = 35.28 + 5968.73 = 6004.01$$

$$\text{Now, required \%} = \frac{6004.01}{26455} \times 100 = 22.7\%$$

Hence, the correct option is (A).

1.126 (B)

Given : The rules for filling in the four symbols:

$\circ$, $\star$, Δ and $\square$ are as follows :

1. Every row and every column must contain each of the 4 symbols.
2. Every 2×2 square delineated by bold lines must contain each of the 4 symbols.

In the given figure there are 4 rows R_1, R_2, R_3, R_4 and 4 columns are C_1, C_2, C_3 and C_4 .

	C_1	C_2	C_3	C_4
R_1		?		Δ
R_2		$\circ$	$\star$	
R_3			$\square$	$\star$
R_4	$\star$		Δ	$\circ$

In the row R_4 symbol $\square$ will be placed in free space and in column C_4 symbol $\square$ will be placed in free space.

	C_1	C_2	C_3	C_4
R_1		?		Δ
R_2		$\circ$	$\star$	$\square$
R_3			$\square$	$\star$
R_4	$\star$	$\square$	Δ	$\circ$

Now, in column C_3 we can place symbol $\circ$ in free space and in row R_2 Δ can be placed.

	C_1	C_2	C_3	C_4
R_1		?	○	△
R_2	△	○	*	□
R_3			□	*
R_4	*	□	△	○

Now, in column C_2 we can have to place symbol * symbol in place of ?, as if can not be use in R_1C_1 , symbol * is already placed in R_4C_1 .

	C_1	C_2	C_3	C_4
R_1		*	○	△
R_2	△	○	*	□
R_3			□	*
R_4	*	□	△	○

After placing symbols at R_3C_1 , R_3C_2 and R_1C_1 the figure will look alike.

	C_1	C_2	C_3	C_4
R_1	□	*	○	△
R_2	△	○	*	□
R_3	○	△	□	*
R_4	*	□	△	○

Hence, the correct option is (B).

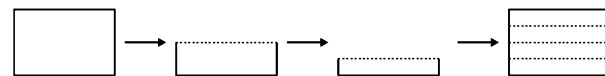
1.127 (C)

Given : A $100\text{ cm} \times 32\text{ cm}$ rectangular sheet is folded 5 times. Each time the sheet is folded, the long edge aligns with its opposite side. Eventually, the folded sheet is a rectangle of dimensions $100\text{ cm} \times 1\text{ cm}$.

The total number of creases visible when sheet is unfolded can be find by following given procedure, let's take a sheet of paper and fold it for one time and open it, total number of creases visible will be one.



Now, fold the paper for two times and unfold it the number of lines visible will be three.



Now, fold the paper for three times and unfold it, the number of lines visible will be eight.



By doing this we can observe, number of creases visible is equals to $(2^n - 1)$,

Here, n = Number of folds.

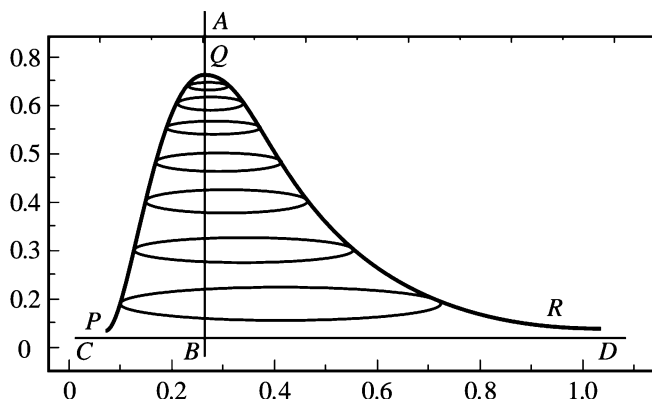
$$2^5 - 1 = 32 - 1 = 31$$

The total number of creases visible when sheet is unfolded is 31.

Hence, the correct option is (C).

1.128 (B)

Given : In the diagram ovals (contour lines) are marked at different heights (h) of a hill. The top view of the hill is best depicts by option Q from the figure we can see AB is perpendicular to CD and the slope of the hill is divided in PQ and QR in two parts.



Slope QR is stretching linearly as it down wards and the ovals are widening from line AB towards slope QP, which we can clearly see in the top view diagram of the hill in figure Q.

Hence, the correct option is (B).

1.129 (C)

According to the given graph.

The ratio of the percentage of population falling into obese category to the percentage of population falling into normal category in 2023 is

$$= \frac{25}{30} = \frac{5}{6} = 0.833$$

The ratio of the percentage of population falling into obese category to the percentage of population falling into normal category in 2003 is

$$= \frac{15}{50} = \frac{3}{10} = 0.3$$

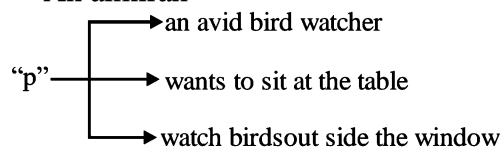
So, the ratio of the percentage of population falling into obese category to the percentage of population falling into normal category as increased in 20 years.

Hence, the correct option is (C).

1.130 (A)

Given :

- (i) Two beds
- (ii) A study table
- (iii) An almirah



Q dose not mind that as long as his bed is close to the ceiling fan.

From, the given explanation (above), option (A) arrangement suits them the most.

Hence, the correct option is (A).

1.131 (C)

- (i) The increase in the number of Millennial car buyers from 2010 to 2015
 $= 45000 - 20000 = 25000$
- (ii) The decrease in the number of Gen X Car buyers from 2010 to 2015
 $= 40000 - 30000 = 10000$

So, the increase in the number of millennial car buyers from 2010 to 2015 is more than the decrease to 2015 in the number of Gen X Car buyers from 2010 to 2015.

Hence, the correct option is (C).

1.132 (C)

From the given graph, it is clear that for any 5000 increment in steps/day. The largest r is reduction occurs on going from 0 to 5000.

Risk at "0" steps/day = 1

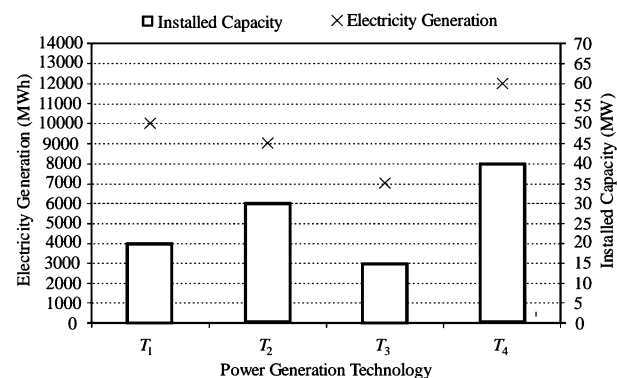
Risk at "5000" steps/day = 0.4 (Approx.)

Risk reduction value (0 – 5000) Range
 $= 1 - 0.4 = 0.6$ (Maximum)

Hence, the correct option is (C).

1.133 (A)

Given :



Capacity factor of a power generation technology is

Capacity factor

$$= \frac{\text{Electricity Generation (MWh)}}{\text{Installed Capacity (MW)} \times 1000 (\text{h})}$$

- (i) Capacity factor of power generation technology T_1 is

From the given chart

Electricity Generation for

$$T_1 = 10000 \text{ MWh}$$

Installed Capacity for $T_1 = 20 \text{ MW}$

$$\text{Capacity factor} = \frac{10000}{20 \times 1000} = 0.5$$

Capacity factor of power generation technology T_1 is 0.5.

- (ii) Capacity factor of power generation technology T_2 is

From the given chart
Electricity generation for

$$T_2 = 9000 \text{ MWh}$$

Installed capacity for $T_2 = 30 \text{ MW}$

$$\text{Capacity factor} = \frac{9000}{30 \times 1000} = 0.3$$

Capacity factor of power generation technology T_2 is 0.3.

- (iii) Capacity factor of power generation technology T_3 is

From the given chart
Electricity generation for

$$T_3 = 7000 \text{ MW}$$

Installed capacity for $T_3 = 15 \text{ MW}$

$$\text{Capacity factor} = \frac{7000}{15 \times 1000} = 0.46$$

Capacity factor of power generation technology T_3 is 0.2.

- (iv) Capacity factor of power generation technology T_4 is

From the given chart
Electricity generation for

$$T_4 = 12000 \text{ MWh}$$

Installed capacity for $T_4 = 40 \text{ MW}$

$$\text{Capacity factor} = \frac{12000}{40 \times 1000} = 0.3$$

Hence, the power generation technology T_1 has the highest capacity factor.

Hence, the correct option is (A).

1.134 (C)

From given graph, it's clear that in years 2016, 2017 and 2018, VK yearly batting average is higher than RS in between 2015 to 2019

$$\text{VK average} = \frac{35 + 90 + 75 + 130 + 60}{5} = 78$$

$$\text{RS average} = \frac{50 + 05 + 70 + 70 + 55}{5} = 64$$

Hence, the correct option is (C).

1.135 (C)

Given : Pie chart presents the percentage contribution of different macronutrients to a typical 2,000 kcal diet of a person.

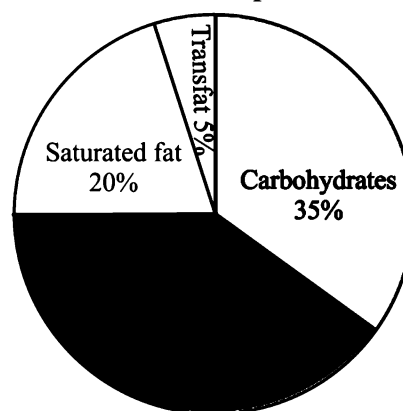


Fig. Macronutrient energy contribution

Energy density (kcal/g) of these macronutrients is

Macronutrient	Energy density (kcal/g)
Carbohydrates	4
Proteins	4
Unsaturated fat	9
Saturated fat	9
Trans fat	9

Total fat consumed by the person

$$= \text{Saturated fat} + \text{Unsaturated fat}$$

$$+ \text{Transfat}$$

$$= 20\% + 20\% + 5\%$$

$$= 45\%$$

Total fat consumed by the person in kcal

$$= \frac{45}{100} \times 2000 = 900 \text{ kcal}$$

From the given table of energy density

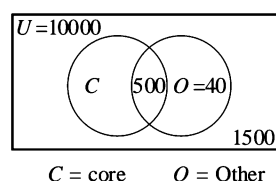
Energy density of all these fats = 9 kcal / gm

Total fat consumed by the person in gram

$$= \frac{900 \text{ kcal}}{9 \text{ kcal/gm}} = 100 \text{ gm}$$

Hence, the correct option is (C).

1.136 (A)



$$C \cap O = 500$$

$$C = \frac{1}{4} O$$

$$O = 4C$$

$$(C \cup O) = 1500$$

$$C \cup O = 10000 - 15000 = U - (C \cup O) = 8500$$

$$C \cup O = 8500$$

$$C \cup O = C + O - C \cap O$$

$$8500 = C + 4C - 500$$

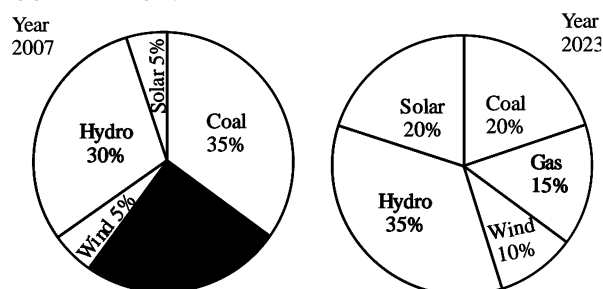
$$5C = 9000$$

$$C = 1800$$

Hence, the correct option is (A).

1.137 (D)

Given : Pie charts depicts the shares of various power generating technologies in the total electricity generation of the country for the years 2007 and 2023.



Share of renewable sources of electricity in year 2007

$$= \text{Hydro } 30\% + \text{Solar } 5\% + \text{Wind } 5\% \\ = 40\%$$

Share of renewable sources of electricity in year 2023

$$= \text{Hydro } 35\% + \text{Solar } 20\% + \text{Wind } 10\% \\ = 65\%$$

Percentage increase in the share of renewable sources of electricity from 2007 to 2023

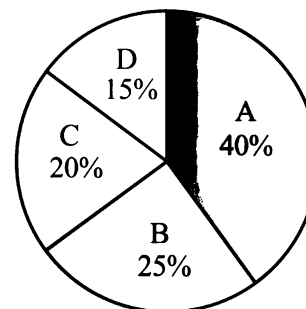
$$= \frac{65 - 40}{40} \times 100 \\ = \frac{25}{40} \times 100 \\ = 62.5\%$$

Hence, the correct option is (D).

1.138 (B)

Given : The Total Number of votes

(i) Cast in the election = 115000



(ii) Out of which 5000 were invalid votes.

(iii) The number of valid votes = 110,000

The Total Number of Valid Votes received by the Candidates B and C is

$$= (25 + 20)\% \text{ of } 110,000 \\ = \frac{45}{100} \times 110,000 \\ = 49500$$

Hence the correct option is (B).

1.139 (B)

Let Annual rate of return of = x

Person 1 amount in year

$$= [10k + 10k(x)] + [20k + 20k(15\%)]$$

$$+ [20k + 20k(15\%)]$$

$$\left[\because \text{Final amount} = \text{original amount} \right. \\ \left. + \text{interest on original amount} \right]$$

Person 1 amount in year

$$= 10k(1+x) + 20k(1.15) + 20k(1.15)$$

$$\dots(i)$$

Similarly,

Person 2 amount in year

$$= [20k + 20k(x)] + [15k + 15k(15\%)]$$

$$+ [15k + 15k(15\%)]$$

Person 2 amount in year

$$= 20k(1+x) + 15k(1.15) + 15k(1.15)$$

$$\dots(ii)$$

Given end of one year the total amount that person 1 gets is 500 Rs. more than person 2.

So, Eqⁿ (i) – Eqⁿ (ii) = 500

$$10k(1.15 - 1 - x) = 500$$

$$0.15 - x = \frac{5}{100}$$

$$100x = 10$$

$$x = 0.1$$

$$x = 0.1 = 10\%$$

Hence, the correct option is (B).

1.140 (C)

Given :

Nation	Gold	Silver	Bronze	Total medals
USA	40	44	41	125
Canada	39	27	24	90
Japan	20	12	13	45
Australia	17	19	16	52
France	16	26	22	64

From option (A) : France will occupy the third place if the list is made on the basis of total medals won.

1. USA (125) 2. Canada (90)

3. France (64) 4. Australia (52)
 5. Japan (45)

This statement is correct.

From option (B) : The order of the top two nations will not change even if the list is made on the basis of total won.

- (•) Based on gold medals, the ranking is
 1. USA (40) 2. Canada (39)
 (•) Based on total medals, the ranking is
 1. USA (125) 2. Canada (90)

This statement is correct.

From option (C) : USA and Canada together have less than 50% of total medals awarded to the nations in the table.

$$\text{Total medals awarded} = 125 + 90 + 45 + 52 + 64$$

$$= 376$$

$$\text{USA} + \text{Canada} = 125 + 90 = 215$$

$$\text{According to statement} = (0.5) \times 376 = 188$$

$$(\text{OR}) = \frac{215}{376} \times 100 = 57.18\%$$

USA and Canada together have 57.18% of the total medals awarded to the nations.

This statement is incorrect.

From option (D) : Canada has won twice as many total medals as Japan.

$$\text{Total medals of Japan} = 45$$

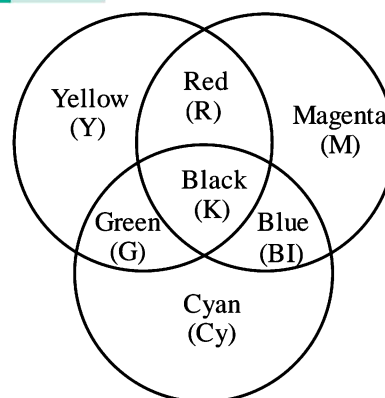
$$\text{Twice of Japan's total medal} = 2 \times 45 = 90$$

$$\text{Total medals of Canada} = 90$$

This statement is correct.

Hence, the correct option is (C).

1.141 (A)



From figure :

Yellow (Y) = Red (R) + Green (G)

Magenta (M) = Red (R) + Blue (B1)

Cyan (CY) = Blue (B1) + Green (G)

Now,

From option (A) :

The colours are placed according to the CMY color model.

- Yellow, Magenta, Cyan colors are correctly positioned.
- Red, Green, Blue, colors are appear at the correct intersection.
- Black is at the centre, where all three (Yellow, Magenta, Cyan) colors overlap. So, this representation of the color model is correct.

From option (B) :

- Green and blue placement are incorrect.
- Black is not properly at the centre where all three (yellow magenta, Cyan) mix. So, this representation of the color model is incorrect.

From option (C) :

- Red is missing in the expected region where Yellow (Y) and Magenta (M) should overlap.
- Incorrect positioning of Black (K), Green (G) and Blue (B1).

So, this representation of the colour model is incorrect.

From option (D) :

- Red (R) is repeated instead of having Blue (B1) in the expected position.
- Incorrect placement of Green (G) and Black (K).

So, this representation of the color model is incorrect.

Hence, the correct option is (A).

1.142 (A)

Given : $Y + 2V = 50$... (i)

$V + G = 50$... (ii)

$Y + R = 50$... (iii)

$V + 2R = 50 \Rightarrow 2V = 50 - 2R$... (iv)

Substitute (iv) in (i),

$Y - 4R = -50$... (v)

Solving (i) and (v), $R = 20$, $Y = 30$

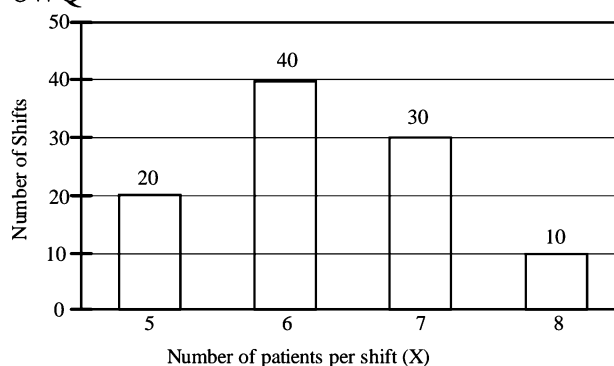
From (i) and (ii), $G = 40$, $V = 10$

Hence, the correct option is (A).

1.143 (A)

The number of patients per shift (X) consulting Dr. Gita in her past 100 shifts is shown in the figure below.

8WQ



From the Histogram :

Number of patients (X)	Number of Shift (f)
5	20
6	40
7	30
8	10
Total Shifts	100

If the amount she earns is given by :

Earning per shift = $1000(X - 0.2)$

The Average number of patients per shift

$$E(X) = \frac{(5 \times 20) + (6 \times 40) + (7 \times 30) + (8 \times 10)}{20 + 40 + 30 + 10}$$

$$E(X) = \frac{100 + 240 + 210 + 80}{100}$$

$$E(X) = \frac{630}{100} = 6.3$$

The Average number of patients per shift is 6.3.

Now, the earning per shift are given by the equation

$$E = 1000(X - 0.2)$$

The Average Earning per shift

$$E_{avg} = 1000(6.3 - 0.2)$$

$$E_{avg} = 1000 \times 6.1 = 6100$$

Thus, the average earnings per shift over the past 100 shift is Rs 6100.

Hence, the correct option is (A).

Engineering Services Examination (ESE)

1. (A)

	Utility Stock	Automotive Stock	Technology Stock	Oil Stock
Anita	×	×	✓	×
Maria	✓	×	×	×
Tony	×	×	×	✓
Jose	×	✓	×	×

Hence, the correct option is (A).

2. (C)

Given :

	Ranking					
Caramel center	5	4	4	4	2	4
Vanilla center	1	5	5	5	5	5
Almond center	2	3	2	1	3	3
Toffee center	4	1	1	3	4	2
Solid chocolate	3	2	3	2	1	1
Number of voters	17	11	9	8	3	2

According to the given table, there are two possibilities : toffee centre and solid chocolate, and only one option has been given in the options.

Hence, the correct option is (C).

3. (B)

Given :

	Ranking					
Avalon	2	2	2	2	3	2
Branson	1	4	4	4	2	1
Columbus	3	3	1	3	1	3
Dunkirk	4	1	3	1	4	4
Number of voters	30	24	18	12	10	6

$$\text{Avalon} \Rightarrow [(30 \times 2) + (24 \times 2) + (18 \times 2)$$

$$+ (12 \times 2) + (10 \times 3) + (2 \times 6)]$$

$$= [60 + 48 + 36 + 24 + 30 + 12]$$

$$= [60 + 60 + 60 + 30]$$

$$= 210$$

$$\text{Branson} \Rightarrow [(1 \times 30) + (4 \times 24) + (4 \times 18)$$

$$+ (4 \times 12) + (2 \times 10) + (1 \times 6)]$$

$$= [30 + 96 + 72 + 48 + 20 + 6]$$

$$= [30 + 120 + 26 + 96] = [272]$$

$$\text{Columbus} \Rightarrow 244$$

$$\text{Dunkirk} \Rightarrow 225$$

Hence the correct option is (B).



2

Syllogism

Introduction :

It helps to think of deductive reasoning in terms of syllogisms.

A syllogism is a deductive argument relating two premises and a conclusion, all of which are quantified propositions, i.e. propositions joining concepts by using words such as 'some' and 'all'.

Deductive logic is used to derive conclusions from premises where the truth of the conclusion must always be contained in the truth of the premises.

Argument : An 'argument expresses a single comprehensive act of thought which gives judgment and is supported by two statements. So it consists of three propositions.

It is divided into two parts: Premises and Conclusion

Premises : Two propositions which support the third proposition giving judgment are called 'Premises'.

Conclusion : The third proposition which gives a judgment and is supported by two premises is called a 'Conclusion'.

Let's consider an argument.

1. All students are wise.
2. Ravi is a student.
3. Ravi is wise.

Here obviously propositions 1 and 2 are the premises and the proposition 3 which follows from the first two propositions, is called the conclusion.

Deductive and Inductive Logic :

Consider the following example.

1. All mammals have lungs.
2. Cow is a mammal.
3. Cow has lungs.

Irrespective of any other characteristics of a cow, i.e. it gives milk, it is white, etc., the conclusion that a cow has lungs holds good, if (1) and (2) above are true.

This is deductive logic.

Some characteristics of deductive logic :

1. It is a valid argument.
2. Nothing can further strengthen this argument, i.e. no statement can make the conclusion more valid.
3. Another way of looking at deductive logic is that when a 'specific conclusion is derived from a set of general statements, then it is deductive logic.

In the previous example, if we alter the sequence of sentences, i.e.

1. Cow is a mammal.
2. Cow has lungs.
3. All mammals have lungs.

The conclusion that all mammals have lungs is not necessarily valid. However, it is not necessarily invalid. There is a probability of this conclusion being true.

This is inductive logic.

Some characteristics of inductive logic.

1. The conclusion cannot be said to be either totally invalid or valid.
2. Addition of certain other premises may make the conclusion either more valid or invalid.
3. Another way of looking at inductive logic is that when a 'general' conclusion is derived from a set of specific statements, then it is inductive logic.

Deductive Logic :

The premises in deductive logic can be either affirmative or negative and can also be universal or particular. Thus we have basically four types of premises as summarized below

	Affirmative	Negative
Universal	All P are Q	No P is Q
Particular	Some P are Q	Some P are not Q

Lets understand each of these four statement in their entirety....

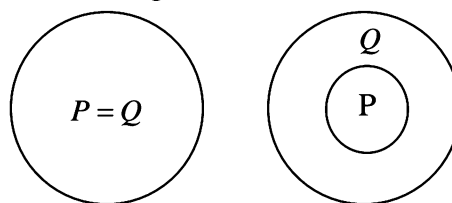
1. All P are Q :

This statement means that there is no P which is not a Q . For those who understand the language of sets, it means that P is a sub – set of Q .

One of the most common mistake made in interpreting this statement is that there are certain Q which are not P . This is false reasoning. It is just a possibility that there are certain Q that are Not P but we cannot be sure of it. It is quite possible that the entire set of P and Q overlap with each other.

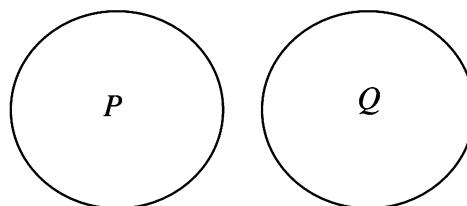
Similarly we also cannot conclude that 'All Q are P ' as there is possibility of some Q not being P

Thus there are two possible Venn diagrams for this statement :



2. No P is Q :

This statement is the simplest and has just one interpretation i.e. the two sets of P and Q are disjoint or do not overlap.



Thus we can conclude that no P is a Q and also that no Q is a P .

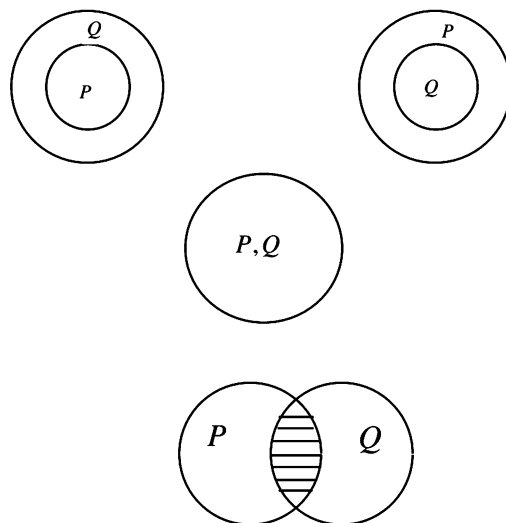
3. Some P are Q :

The meaning of this statement is that there is atleast one P which is a Q

Thus we can also conclude from this statement that 'some Q are P ' because there is atleast one entity which is both a P and Q .

This statement is most prone to be misunderstood. One of the most common misunderstandings of this statement is the conclusion 'Some P are not Q '. Please note 'Some P are Q ' does not mean 'Some P are not Q '. Understand it this way: the faculty of a class knows two individuals of the class personally and know that they are intelligent. Thus he is right in saying 'some students of this class are intelligent'. At the same time all the student may also be intelligent, it is just that he does not know them well. The faculty when he says that some students of this class are intelligent is just referring to those two individuals. The faculty is not making a remark on the others. The others may also be intelligent.

In fact, there are FOUR possible Venn diagrams for this statement.



4. **Some P are not Q :**

Again here we know that there is atleast one P which is not a Q .

Please note the 'atleast'. It is quite possible that no P may be a Q . Thus the conclusion that "some P are Q " cannot follow this statement.

To Summarize :

Statements	Correct conclusion	Commonly made wrong conclusion
All P are Q	Some Q are P	All Q are P
No P is Q	No Q is P	_____
Some P are Q	Some Q are P	Some P are not Q
Some P are not Q	_____	Some P are Q
		Some Q are not P



2010 IIT Guwahati

- 2.1** A gathering of 50 linguists discovered that 4 knew Kannada, Telugu and Tamil, 7 knew only Telugu and Tamil, 5 knew only Kannada and Tamil, 6 knew only Telugu and Kannada. If the number of linguists who knew Tamil is 24 and those who knew Kannada is also 24, how many linguists knew only Telugu? [TF]
- (A) 9 (B) 10
(C) 11 (D) 8

2011 IIT Madras

- 2.2** In a class of 300 students in an M.Tech programme, each student is required to take at least one subject from the following three:
- M600 : Advanced Engineering Mathematics
C600 : Computational Methods for Engineers
E600 : Experimental Techniques for Engineers
- The registration data for the M.Tech class shows that 100 students have taken M600, 200 students have taken C600, and 60 students have taken E600. What is the maximum possible number of students in the class who have taken all the above three subjects? [GG, TF]
- (A) 20 (B) 30
(C) 40 (D) 50

2013 IIT Bombay

- 2.3** All professors are researchers
Some scientists are professors
Which of the given conclusions is logically valid and is inferred from the above arguments :
[AE, AG, BT, CH, CY, MN, XE, XL]

- (A) All scientists are researchers
(B) All professors are scientists
(C) Some researchers are scientists
(D) No conclusion follows

2014 IIT Kharagpur

- 2.4** Read the statements :
All women are entrepreneurs.
Some women are doctors.
Which of the following conclusions can be logically inferred from the above statements? [EC-1, ME-1]
- (A) All women are doctors.
(B) All doctors are entrepreneurs.
(C) All entrepreneurs are women.
(D) Some entrepreneurs are doctors.

2015 IIT Kanpur

- 2.5** Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows :
- Statements :**
I. No manager is a leader.
II. All leaders are executive.
- Conclusions :**
I. No manager is an executive.
II. All executives are manager.
[AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]
- (A) Only conclusion I follows.
(B) Only conclusion II follows.
(C) Neither conclusion I nor II follows.
(D) Both conclusion I and II follow.
- 2.6** Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows : [EC-2, ME-1]

Statements :

- I. All film stars are playback singers.
 II. All film directors are film stars.

Conclusions :

- I. All film directors are playback singers.
 II. Some film stars are film directors.
 (A) Only conclusion I follows.
 (B) Only conclusion I nor II follows.
 (C) Neither conclusion I nor II follows.
 (D) Both conclusions I and II follow.

- 2.7** There are 16 teachers who can teach Thermodynamics (TD), 11 who can teach Electrical Sciences (ES), and 5 who can teach both TD and Engineering mechanics (EM). There are a total of 40 teachers, 6 can not teach any of the three subjects, i.e. EM, ES and TD. 4 can teach ES and TD. How many can teach both ES and EM but not TD? **[CE-2]**

- (A) 1 (B) 2
 (C) 3 (D) 4

2016 IISc Bangalore

- 2.8** Fact 1 : Humans are mammals.
 Fact 2 : Some humans are engineers.
 Fact 3 : Engineers build house.
 If the above statements are facts, which of the following can be logically inferred? **[AG, CE-2, EY, MT, PI]**
 I. All mammals build houses.
 II. Engineers are mammals.
 III. Some humans are not engineers.
 (A) II only (B) III only
 (C) I, II and III (D) I only

2017 IIT Roorkee

- 2.9** Some tables are shelves. Some shelves are chairs. All chairs are benches. Which of the following conclusions can be deduced from the preceding sentences? **[BT, CY, EC-1, EY, PI]**

- (i) At least one bench is a table.
 (ii) At least one shelf is a bench.
 (iii) At least one chair is a table.
 (iv) All benches are chairs.
 (A) Only (i)
 (B) Only (ii)
 (C) Only (ii) and (iii)
 (D) Only (iv)

- 2.10** Consider the following sentences :
 All benches are beds. No bed is a bulb.
 Some bulbs are lamps.

Which of the following can be inferred?

[CE-1, CH, MN]

- (i) Some beds are lamps.
 (ii) Some lamps are beds.
 (A) Only (i)
 (B) Only (ii)
 (C) Both (i) and (ii)
 (D) Neither (i) nor (ii)

2018 IIT Guwahati

- 2.11** Consider the following three statements
 (i) Some roses are red.
 (ii) All red flowers fade quickly.
 (iii) Some roses fade quickly.
 Which of the following statements can be logically inferred from the above statements? **[EY, ME-1, PE, XE, XL]**
 (A) If (i) is true & (ii) is false, then (iii) is false
 (B) If (i) is true & (ii) is false, then (iii) is true
 (C) If (i) & (ii) are true, then (iii) is true
 (D) If (i) & (ii) are false, then (iii) is false
- 2.12** Forty students watched films A, B and C over a week. Each student watched either only one film or all three. Thirteen students watched film A, sixteen students

watched film B and nineteen students watched film C. How many students watched all three films?

[AE, MA, ME-2, PI]

- (A) 0 (B) 2
(C) 4 (D) 8

2019 IIT Madras

- 2.13** In a sports academy of 300 people, 105 play only cricket, 70 play only hockey, 50 play only football, 25 play both cricket and hockey, 15 play both hockey and football and 30 play both cricket and football. The rest of them play all three sports. What is the percentage of people who play at least two sports? [CE-1]

- (A) 25.00 (B) 28.00
(C) 23.30 (D) 50.00

- 2.14** In a college, there are three student clubs. Sixty students are only in the Drama club, 80 students are only in the Dance club, 30 student are only in the Maths club, 40 students are in both Drama and Dance clubs, 12 students are in both Dance and Maths clubs, 7 students are in both Drama and Maths clubs, and 2 students are in all the clubs. If 75% of the students in the college are not in any of these clubs, then the total number of students in the college is ____.

[CH, CS]

- (A) 1000 (B) 975
(C) 900 (D) 225

- 2.15** Some students were not involved in the strike. [AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]

If the above statement is true, which of the following conclusions is/are logically necessary?

1. Some who were involved in the strike were students.

2. No student was involved in the strike.
3. At least one student was involved in the strike.
4. Some who were not involved in the strike were students.

- (A) 1 and 2 (B) 3
(C) 4 (D) 2 and 3

2020 IIT Delhi

- 2.16** The global financial crisis in 2008 is considered to be the most serious worldwide financial crisis, which started with the sub-prime lending crisis in USA in 2007. The sub-prime lending crisis led to the banking crisis in 2008 with the collapse of Lehman Brothers in 2008. The sub-prime lending refers to the provision of loans to those borrowers who may have difficulties in repaying loans, and it arises because of excess liquidity following the East Asian crisis. Which one of the following sequences shows the correct precedence as per the given passage? [EC]

- (A) East Asian crisis → subprime lending crisis → banking crisis → global financial crisis.
(B) Banking crisis → subprime lending crisis → global financial crisis → East Asian crisis.
(C) Global financial crisis → East Asian crisis → banking crisis → subprime lending crisis.
(D) Subprime lending crisis → global financial crisis → banking crisis → East Asian crisis.

- 2.17** Crowd funding deals with mobilisation of funds for a project from a large number of people, who would be willing to invest smaller amounts through web-based platforms in the project.

Based on the above paragraph, which of the following is correct about crowd funding? [IN, ME-1, MT, PE, PH]

- (A) Funds raised through voluntary contributions on web-based platforms.
- (B) Funds raised through unwilling contributions on web-based platforms.
- (C) Funds raised through large contributions on web-based platforms.
- (D) Funds raised through coerced contributions on web-based platforms.

- 2.18** Climate change and resilience deal with two aspects - reduction of sources of nonrenewable energy resources and reducing vulnerability of climate change aspects. The terms 'mitigation' and 'adaptation' are used to refer to these aspects, respectively.

Which of the following assertions is best supported by the above information?

[CY, ME-2, PI]

- (A) Mitigation deals with consequences of climate change.
- (B) Adaptation deals with causes of climate change.
- (C) Mitigation deals with actions taken to reduce the use of fossil fuels.
- (D) Adaptation deals with actions taken to combat green-house gas emissions.

- 2.19** The American psychologist Howard Gardner expounds that human intelligence can be sub-categorised into multiple kinds, in such a way that individuals differ with respect to their relative competence in each kind. Based on this theory, modern educationists

insist on prescribing multi-dimensional curriculum and evaluation parameters that enable development and assessment of multiple intelligences.

Which of the following statements can be inferred from the given text? [CE-1]

- (A) Howard Gardner insists that the teaching curriculum and evaluation needs to be multi-dimensional.
- (B) Modern educationists insist that the teaching curriculum and evaluation needs to be multi-dimensional.
- (C) Modern educationists want to develop and assess the theory of multiple intelligences.
- (D) Howard Gardner wants to develop and assess the theory of multiple intelligences.

- 2.20** The dawn of the 21st century witnessed the melting glaciers oscillating between giving too much and too little to billions of people who depend on them for fresh water. The UN climate report estimates that without deep cuts to man-made emissions, at least 30% of the northern hemisphere's surface permafrost could melt by the end of the century. Given this situation of imminent global exodus of billions of people displaced by rising seas, nation-states need to rethink their carbon footprint for political concerns, if not for environmental ones.

Which one of the following statements can be inferred from the given passage?

[CS]

- (A) Nation-states do not have environmental concerns.
- (B) Billions of people are responsible for man-made emissions.
- (C) Billions of people are affected by melting glaciers.

(D) Nation-states are responsible for providing fresh water to billions of people.

- 2.21** Goods and Services Tax (GST) is an indirect tax introduced in India in 2017 that is imposed on the supply of goods and services, and it subsumes all indirect taxes except few. It is a destination-based tax imposed on goods and services used, and it is not imposed at the point of origin from where goods come. GST also has a few components specific to state governments, central government and Union Territories (UTs).

Which one of the following statements can be inferred from the given passage?

[CS]

- (A) GST is imposed at the point of usage of goods and services.
- (B) GST does not have a component specific to UT.
- (C) GST includes all indirect taxes.
- (D) GST is imposed on the production of goods and services.

- 2.22** Repo rate is the rate at which Reserve Bank of India (RBI) lends commercial banks, and reverse repo rate is the rate at which RBI borrows money from commercial banks.

Which of the following statements can be inferred from the above passage?

[AR, BM, BT, CH, MA, MN, ST, XE, XL]

- (A) Decrease in repo rate will decrease cost of borrowing and increase lending by commercial banks.
- (B) Decrease in repo rate will increase cost of borrowing and decrease lending by commercial banks.
- (C) Increase in repo rate will decrease cost of borrowing and decrease lending by commercial banks.

(D) Increase in repo rate will increase cost of borrowing and Increase lending by commercial banks.

- 2.23** Hit by floods, the Kharif (summer sown) crops in various parts of the country have been affected. Officials believe that the loss in production of the kharif crops can be recovered in the output of the rabi (winter sown) crops so that the country can achieve its food-grain production target of 291 million tons in the crop year 2019-20 (July-June). They are hopeful that good rains in July-August will help the soil retain moisture for a longer period, helping winter sown crops such as wheat and pulses during the November-February period.

Which of the following statements can be inferred from the given passage?

[AR, BM, BT, CH, MA, MN, ST, XE, XL]

- (A) Officials want the food-grain production target to be met by the November-February period.
- (B) Officials feel that the food-grain production target cannot be met due to floods.
- (C) Officials declared that the food-grain production target will be met due to good rains.
- (D) Officials hope that the food-grain production target will be met due to good rabi produce.

2021

IIT Bombay

- 2.24** Given below are two statements and two conclusions.

Statement :

Statement 1 : All purple are green.

Statement 2 : All black are green.

Conclusion :

Conclusion I : Some black are purple

Conclusion II : No black is purple

Based on the above statements and conclusions, which one of the following options is logically **CORRECT**?

[EC, ES, PE, PI, ST]

(A) Both conclusion I & II are correct.

(B) Only conclusion I is correct.

(C) Only conclusion II is correct.

(D) Either conclusion I or II is correct.

2.25 1. Some football players play cricket.

2. All cricket players play hockey.

Among the options given below, the statement that logically follows from the two statements 1 and 2 above, is

[AE, AR, BM, CE-2, MN, PH]

(A) All football players play hockey.

(B) Some football players play hockey.

(C) No football player plays hockey.

(D) All hockey players play football.

2.26 Given below are two statements 1 and 2, and two conclusions I and II.

Statement 1 : All entrepreneurs are wealthy.

Statement 2 : All wealthy are risk seekers.

Conclusion I : All risk seekers are wealthy.

Conclusion II : Only some entrepreneurs are risk seekers.

Based on the above statements and conclusions which one of the following options is **CORRECT**? [ME-2, MT]

(A) Only conclusion I is correct.

(B) Only conclusion II is correct.

(C) Both conclusion I and II are correct.

(D) Neither conclusion I nor II is correct.

2.27 Given below are two statements 1 and 2, and two conclusions I and II.

Statement 1 : All bacteria are microorganisms.

Statement 2 : All pathogens are microorganisms.

Conclusion I : Some pathogens are bacteria.

Conclusion II : All pathogens are not bacteria.

Based on the above statements and conclusions, which one of the following options is logically **CORRECT**?

[BT, CH, CS-1, MA, TF]

Options

(A) Only conclusion I correct.

(B) Only conclusion II is correct.

(C) Either conclusion I or II is correct.

(D) Neither conclusion I nor II is correct.

2022 IIT Kharagpur

2.28 Given below are four statements

Statement 1 : All students are inquisitive

Statement 2 : Some students are inquisitive

Statement 3 : No students are inquisitive

Statement 4 : Some students are not inquisitive

For the given four statements, find the statements what cannot be true, simultaneously, assuming that there is at least one student in the class

[CSE]

(A) Statement 1 and Statement 3

(B) Statement 3 and Statement 4

(C) Statement 2 and Statement 4

(D) Statement 1 and Statement 2

2.29 Given below are two statements and four conclusions drawn based on the statements.

Statement 1 : Some bottles are cups.

Statement 2 : All cups are knives.

Conclusion I : Some bottles are knives.

Conclusion II : Some knives are cups.

Conclusion III : All cups are bottles.

Conclusion IV : All knives are cups.

Which one of the following options can be logically inferred?

[EE]

(A) Only conclusion II and conclusion III are correct

(B) Only conclusion II and conclusion IV are correct

(C) Only conclusion III and conclusion IV are correct

(D) Only conclusion I and conclusion II are correct

2.30 Given below are three statements and four conclusions drawn based on the statements.

Statement 1 : Some engineers are writers.

Statement 2 : No writer is an actor.

Statement 3 : All actors are engineers.

Conclusion I : Some writers are engineers.

Conclusion II : All engineers are actors.

Conclusion III : No actor is a writer.

Conclusion IV : Some actors are writers.

Which one of the following options can be logically inferred?

[IN, CH, PI]

(A) Only conclusion I is correct

(B) Only conclusion I and conclusion III are correct

(C) Either conclusion III or conclusion IV is correct

(D) Only conclusion II and conclusion III are correct

2.31 Given below are two statements and four conclusion drawn based on the statements?

Statement 1 : Some soaps are clean

Statement 2 : All clean objects are wet.

Conclusion I : Some clean objects are soaps.

Conclusion II : No clean objects is a soap.

Conclusion III : Some wet object are soaps.

Conclusion IV : All wet object are soaps.

Which one of the following option can be logically inferred.

[CE-2]

(A) Either conclusion III or conclusion IV is

(B) Either conclusion I or conclusion II is correct

(C) Only conclusion I is correct

(D) Only conclusion I and conclusion III are correct

2.32 Given below are three conclusions drawn based on the following three statements.

Statement 1: All teachers are professors.

Statement 2: No professor is a male.

Statement 3: Some males are engineers.

Conclusion I: No engineer is a professor.

Conclusion II: Some engineers are professors.

Conclusion III: No male is a teacher.

Which one of the following options can be logically inferred?

[ME-1]

(A) Only conclusion III is correct

(B) Only conclusion I and conclusion II are correct

(C) Only conclusion II and conclusion III are correct

(D) Only conclusion I and conclusion III are correct

2023 IIT Kanpur

- 2.33** Based only on the truth of the statement 'Some humans are intelligent', which one of the following options can be logically inferred with certainty?

[CE-1]

- (A) No human is intelligent
 (B) All humans are intelligent
 (C) Some non-humans are intelligent
 (D) Some intelligent beings are humans

- 2.34** Human beings are one among many creatures that inhabit an imagined world. In this imagined world, some creatures are cruel. If in this imagined world, it is given that the statement "Some human beings are not cruel creatures" is FALSE, then which of the following set of statement(s) can be logically inferred with certainty?

[CH, PI]

- (i) All human beings are cruel creatures.
 (ii) Some human beings are cruel creatures.
 (iii) Some creatures that are cruel are human beings.
 (iv) No human beings are cruel creatures.
 (A) only (i)
 (B) only (iii) and (iv)
 (C) only (i) and (ii)
 (D) (i), (ii) and (iii)

2024 IISc Bangalore**2.35 Statements :**

1. All heroes are winners.
2. All winners are lucky people.

Inferences :

- I. All lucky people are heroes.
- II. Some lucky people are heroes.
- III. Some winners are heroes.

Which of the above inferences can be logically deduced from statements 1 and 2 ?

- (A) Only I and II (B) Only II and III
 (C) Only I and III (D) Only III

[IN, CE-2]

- 2.36** Sequence the following sentences in a coherent passage.

P : This fortuitous geological event generated a colossal amount of energy and heat that resulted in the rocks rising to an average height of 4 km across the contact zone.

Q : Thus, the geophysicists tend to think of the Himalayas as an active geological event rather than as a static geological feature.

R : The natural process of the cooling of this massive edifice absorbed large quantities of atmospheric carbon dioxide, altering the earth's atmosphere and making it better suited for life.

S : Many millennia ago, a breakaway chunk of bedrock from the Antarctic Plate collided with the massive Eurasian Plate.

- (A) QPSR (B) QSPR
 (C) SPRQ (D) SRPQ

[CS-2]

- 2.37** Thousands of years ago, some people began dairy farming. This coincide with a number of mutations on a particular gene that resulted in these people developing the ability to digest dairy milk.

Based on the given passage, which of the following can be inferred ?

- (A) All human beings can digest dairy milk
 (B) No human being can digest dairy milk

(C) Digestion of dairy milk is essential for human beings

(D) In human beings, digestion of dairy milk resulted from a mutated gene

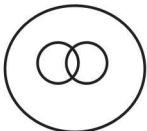
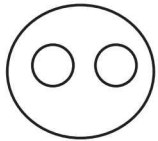
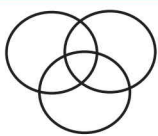
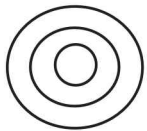
[PI, DA]

2025 IIT Roorkee

2.38 Each row of **Column-I** has three items and each item is represented by a circle in **Column-II**. The arrangement of circles in Column-II represents the relationship among the items in Column-I.

Identify the option that has the most appropriate match between Column-I and Column-II. [EE]

Note : The figures shown are representative.

Column-I		Column-II	
(1)	Animals, Zebra, Giraffe	(P)	
(2)	Director, Producer, Actor	(Q)	
(3)	Word, Sentence, Novel	(R)	
(4)	Pianist, Guitarist, Instrumentalist	(S)	

(A) (1)-(Q); (2)-(P); (3)-(S); (4)-(R)

(B) (1)-(Q); (2)-(R); (3)-(S); (4)-(P)

(C) (1)-(S); (2)-(P); (3)-(R); (4)-(Q)

(D) (1)-(R); (2)-(S); (3)-(Q); (4)-(P)

2026 IIT Guwahati

3.39 Rishi and Swathi are students of Class 5. Pavan and Tanvi are students of Class 4.

Rishi and Pavan are boys. Swathi and Tanvi are girls. The four students played a total of three games of chess. The games were played one after another. A player who lost a game did not participate in any more games. It was observed that :

- (i) The first game was the only game where two students of the same class played against each other,
- (ii) The students of Class 5 won more games than the students of class 4, and
- (iii) The boys won two games and the girls won one game.

The student who did not lose any game is

[DA]

- (A) Pavan (B) Rishi
- (C) Swathi (D) Tanvi

3.40 'When it is raining, peacocks dance.

[CS-2]

Based only on this sentence, which one of the following options is necessarily true?

- (A) Peacocks dance only when it is raining.
- (B) When peacocks dance, it is raining.
- (C) When peacocks are not dancing, it is not raining.
- (D) When it is not raining, peacocks do not dance.

Engineering Services Examination (ESE)

1. Consider the following gold articles P, Q, R, S and T with different weights :
- P weighs twice as much as Q
 - Q weighs four and a half times as much as R
 - R weighs half as much as S
 - S weighs half as much as T
 - T weighs less than P but more than R
- Article T will be lighter in weight than :
- (A) P and S (B) P and R
(C) P and Q (D) Q and R

[ESE 2020]

2. In a group of 1000 people, 750 speak Hindi and 400 speak English. The number of only Hindi speaking people is:
- (A) 150 (B) 350
(C) 600 (D) 750

[ESE 2020]

3. A, B, C, D and E are five different integers. When written in the ascending order of values, the difference between any two adjacent integers is 4. D is the greatest and A is the least. B is greater than E but less than C. The sum of the integers is equal to E. What is the positive difference between the lowest and the highest integers ?
- (A) 8 (B) 6
(C) 16 (D) 18

[ESE 2021]

4. Fact 1 : Jessica has four children.
Fact 2 : Two of the children have blue eyes and two of the children have brown eyes.
Fact 3 : Half of the children are girls.
If the first three statements are facts, which of the following statements must also be a fact?

I. At least one girl has blue eyes.

II. Two of the children are boys.

III. The boys have brown eyes.

Select the correct answer using the code given below:

(A) II only

(B) I and III only

(C) II and III only

(D) None of the statements is a known fact

[ESE 2022]

5. Children are in pursuit of a dog whose leash has broken. James is directly behind the dog. Ruby is behind James. Rachel is behind Ruby. Max is ahead of the dog walking down the street in the opposite direction. As the children and dog pass, Max turns around and joins the pursuit. He runs in behind Ruby. James runs faster and is alongside the dog on the left. Ruby runs faster and is alongside the dog on the right. Which child is directly behind the dog ?
- (A) James (B) Ruby
(C) Rachel (D) Max

[ESE 2022]

6. The question given below has three statements followed by three conclusions numbered I, II and III. You have to take the given statements to be true even if they seem to be at variance from commonly known facts. Read all the conclusions and then decide which of the given conclusions logically follows from the given statements disregarding commonly known facts.
- Statements :
- All lions are tigers.
All tigers are leopards.
Some leopards are wolves.

Conclusions :

- I. No elephant is lion.
 - II. Some wolves are lions.
 - III. Some leopards are lions.
- (A) Only I follows
(B) Only II follows
(C) Only III follows
(D) Only I and III follow

[ESE 2023]

7. An activities director for a cruise ship has surveyed 240 passengers. Of the 240 passengers, 135 like swimming, 80 like swimming and dancing, 150 like dancing, 40 like swimming and games, 65 like games, 25 like dancing and games, 15 like all three activities. How many passengers like exactly two of the three types of activities?
- (A) 220 (B) 20
(C) 30 (D) 100

[ESE 2024]

8. Read the following information and answer the question:
- Seven students P, Q, R, S, T, U and V take a series of tests. No two students get similar marks. V always scores more than P. P always scores more than Q. Each time either R scores the highest and T gets the least, or alternatively S scores the highest and U or Q scores the least.
- If V is ranked fifth, which one of the following is correct?
- (A) S scores the highest
(B) R is ranked second
(C) T is ranked third
(D) Q is ranked fourth

[ESE 2024]

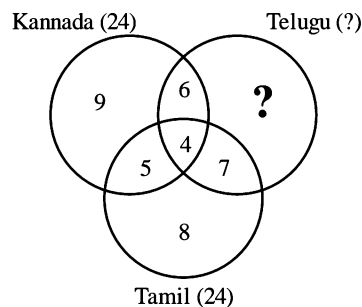
Answers		Syllogism							
2.1	C	2.2	B	2.3	C	2.4	D	2.5	C
2.6	D	2.7	A	2.8	B	2.9	B	2.10	D
2.11	C	2.12	C	2.13	A	2.14	C	2.15	C
2.16	A	2.17	A	2.18	C	2.19	B	2.20	C
2.21	A	2.22	A	2.23	D	2.24	D	2.25	B
2.26	D	2.27	C, D	2.28	A	2.29	D	2.30	B
2.31	D	2.32	A	2.33	D	2.34	D	2.35	B
2.36	C	2.37	D	2.38	B	3.39	D	3.40	C
Engineering Services Examination (ESE)									
1.	C	2.	C	3.	C	4.	A	5.	D
6.	C	7.	D	8.	A				

Explanations

Syllogism

2.1 (C)

According to the given data, Venn diagram can be drawn as shown below



Only Kannada : $24 - (6 + 4 + 5) = 9$

Only Tamil : $24 - (5 + 4 + 7) = 8$

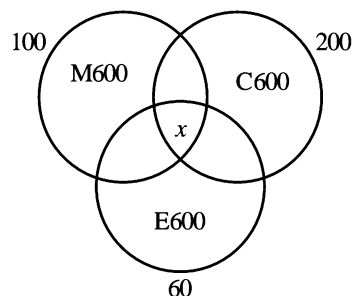
Telugu : $50 - (9 + 5 + 8) = 28$

Only Telugu : $28 - (6 + 4 + 7) = 11$

Hence, the correct option is (C).

2.2 (B)

According to the given data, Venn diagram can be drawn as shown below



Let the number of students who took all courses be x .

The maximum possible number will be :

$$100 - x + 200 - x + 60 - x = 300 - x$$

$$360 - 3x = 300 - x$$

$$2x = 60$$

$$x = 30$$

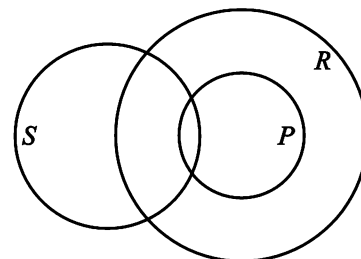
Hence, the correct option is (B).

2.3 (C)

Given :

- (i) All professors are researchers.
- (ii) Some scientists are professors.

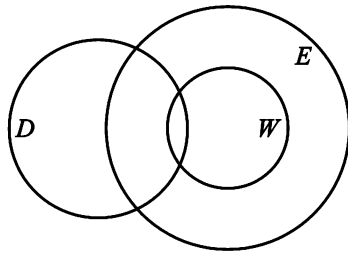
According to given data, venn diagram can be drawn as shown below,



From the given options, only option (C) logically follows.

Hence, the correct option is (C).

2.4 (D)



Hence, the correct option is (D).

2.5 (C)

Given :

S1 : No manager is a leader.



S2 : All leaders are executive.

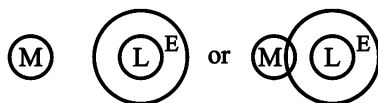


Fig. (a)

Fig.(b)

Conclusion 1 :

No manager is an executive.

From possibility of case presented in figure (b), conclusion 1 does not follow.

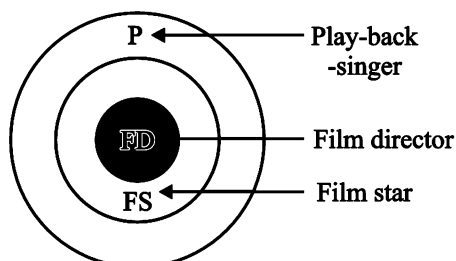
Conclusion 2 :

From figure (a) and figure (b), it is clear that in any case, all executives cannot be managers. So, conclusion 2 also does not follow.

Hence, the correct option is (C).

2.6 (D)

The possible Venn diagram drawn from the given statements is :

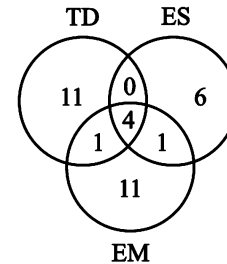


From this diagram, conclusions I and II logically follows.

Hence, the correct option is (D).

2.7 (A)

According to the given data, Venn diagram can be drawn as shown below,



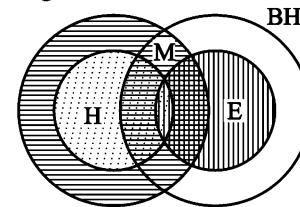
So, number of teachers who can teach both ES and EM is 1.

Hence, the correct option is (A).

2.8 (B)

From given facts, the following Venn diagram can be drawn,

H = Humans M = Mammals
E = Engineers BH = Build houses

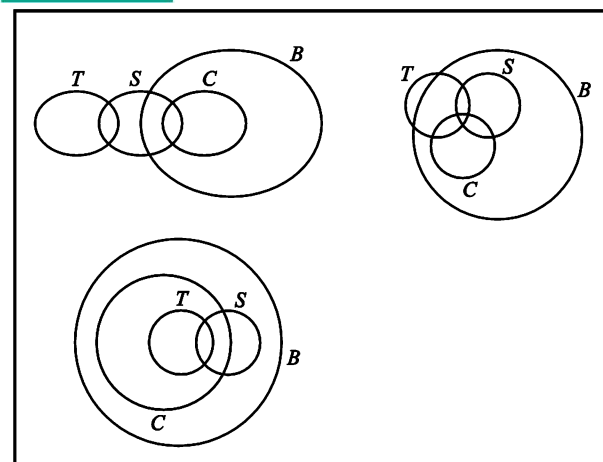


From above diagram, only statement III is true.

Hence, the correct option is (B).

2.9 (B)

Method 1



Only conclusion (ii) follows.

Hence, the correct option is (B).

Method 2

Some tables are shelves,

$$T \in S \quad \dots(i)$$

Some shelves are chairs,

$$S \in C \quad \dots(ii)$$

All chairs are benches,

$$C = B \quad \dots(iii)$$

Using equation (ii) and (iii),

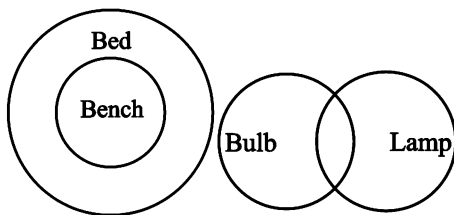
$$S \in B$$

Therefore, at least one shelf is a bench.

Hence, the correct option is (B).

2.10 (D)

According to the given data, venn diagram is shown below,



None of the given statements can be inferred according to the venn diagram.

Hence, the correct option is (D).

2.11 (C)

Given :

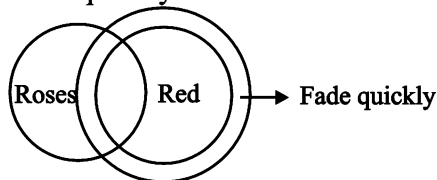
- (i) Some roses are red.
- (ii) All red flowers fade quickly.
- (iii) Some roses fade quickly.

Option (A) and (B) :

If some roses are red and red flowers don't fade quickly then it cannot be inferred whether some roses fade quickly or not.

Therefore, option (A) and (B) are incorrect.

Option (C) : If some roses are red and all red flowers fade quickly.



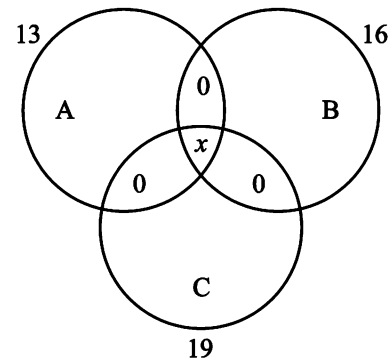
It can be inferred from above Venn diagram that some roses fade quickly.

Therefore, if statement (i) and (ii) are true, then statement (iii) is also true.

Hence, the correct option is (C).

2.12 (C)

Let 'x' number of students watched all three movies. According to given data, Venn diagram can be drawn as shown below,



Number of students	Watched only
$13 - x$	A
$16 - x$	B
$19 - x$	C

Total students

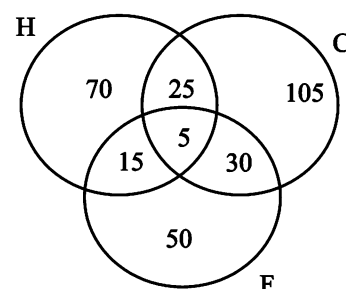
$$= 13 - x + 16 - x + 19 - x + x = 40$$

$$x = 4$$

Hence, the correct option is (C).

2.13 (A)

According to the given data, Venn diagram can be drawn as shown below,



Number of people who play at least two sports

$$= (15 + 25 + 30) \text{ (2 sports)} + 5 \text{ (3 sports)}$$

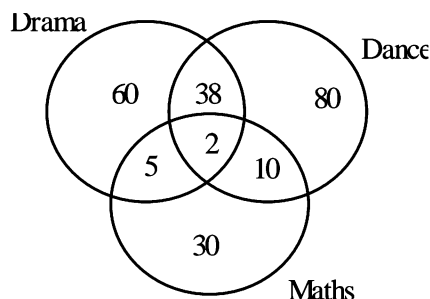
$$= 75$$

$$\% \text{ of people} = \frac{75}{300} \times 100 = 25\%$$

Hence, the correct option is (A).

2.14 (C)

According to the given data, Venn diagram can be drawn as shown below,



Let total number of students is x .

75% of the students are not in any club. So,

$$x = 60 + 80 + 30 + 38 + 10 + 5 + 2 + 0.75x$$

$$0.25x = 225$$

$$x = 900$$

Hence, the correct option is (C).

2.15 (C)

For above statements, Venn – diagram can be form as shown below,



According to the Venn diagram, it can be inferred that some who were not involved in the strike were students and some who were involved in the strike were students. So statements 1 and 4 can be inferred. According to the options only option (C) can be correct.

Hence, the correct option is (C).

2.16 (A)

According to the given paragraph, because of East Asian crisis, sub-prime lending crisis occurred due to access liquidity and hence banking crisis taken place resulting in the global financial crisis.

Hence, the correct option is (A).

2.17 (A)

The given paragraph clearly mentions “willing to invest smaller amounts” therefore it can be inferred that crowd funding are the funds raised through voluntary contributions.

Hence, the correct option is (A).

2.18 (C)

The given passage clearly mentions “reduction of sources of non-renewable energy resources”, therefore, the term “mitigation” refers to reducing the usage of fossil fuels.

Hence, the correct option is (C).

2.19 (B)

Since, the theory is already given or formulated. Therefore, option (D) is incorrect.

Howard Gardner is not related to teaching curriculums. Therefore, option (A) is incorrect.

Modern educationists have little to do with developing theories. Therefore, option (C) is also incorrect.

The given passage indicates that modern educationists insist on prescribing multi-dimensional curriculum and evaluation parameters that enable development and assessment of multiple intelligences.

Hence, the correct option is (B).

2.20 (C)

From the given passage : ‘Global exodus of billions of people displaced by rising seas’ clearly implies that billions of people are affected by melting glaciers.

Hence, the correct option is (C).

2.21 (A)

The given passage mentions that GST is ‘a destination based tax imposed on goods and services used’, therefore it can be inferred that

GST is imposed at the point of usage of goods and services.

Hence, the correct option is (A)

2.22 (A)

Repo rate is the rate at which RBI lends commercial banks. The decrease in repo rate increases the flow of money in the economy, hence, increase leading by commercial banks and decrease cost of borrowing.

Hence, the correct option is (A).

2.23 (D)

Officials are hopeful that good rains in July-August will help to recover loss in longer period. Therefore, it can be inferred from the passage that the officials hope that the food grain production target will be met due to great rabi produce.

Hence, the correct options is (D).

2.24 (D)

Given :

S1 : All purple are green.

S2 : All Black are green.

According to the statement given in the question we can form Venn diagram as shown below, There are two possibilities,

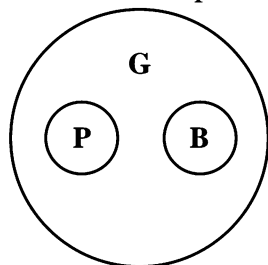


Fig. (a)

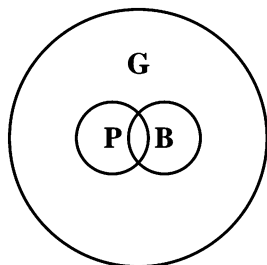


Fig. (b)

Conclusion 1 : Some black are purple.

From fig. (a) conclusion 1 does not follow.

Conclusion 2 : No black is purple.

From possibility of case present in fig. (b) conclusion 2 does not follow.

Here, both the conclusion are wrong by can't say condition as there is no direct relation given between variable purple and black.

And variable of the conclusion are same.

Also one conclusion is positive and another is negative.

Therefore they full fill the conditional case of "either-or".

Hence, the correct option is (D).

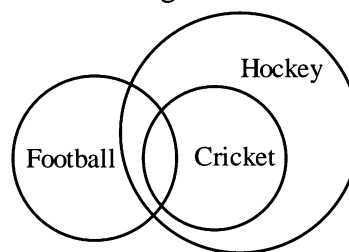
2.25 (B)

Given :

S1 : Some football players play cricket.

S2 : All cricket players play hockey.

According to the statement given in the question we can form Venn diagram as shown below,



By the logical Venn diagram we can conclude

Option (A) : is wrong by can't say condition.

Option (B) : logically follows the statements.

Option (C) : is definitely wrong.

Option (D) : is wrong by can't say condition.

Hence, the correct option is (B).

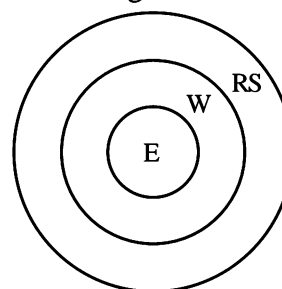
2.26 (D)

Given :

S1 : All entrepreneurs are wealthy

S2 : All wealthy are risk seekers

According to the statement given in the question we can form Venn diagram as shown below,



Conclusion 1 : Can't say (Wrong) : As all wealthy are risk seekers.

Conclusion 2 : Definitely wrong : As all entrepreneurs are risk seekers.

Hence, the correct option is (D).

2.27 (C, D)

Given :

S1 : All bacteria are microorganisms.

S2 : All pathogens are microorganisms.

According to the statement given in the question we can form Venn diagram as shown below,

There are two possibilities,

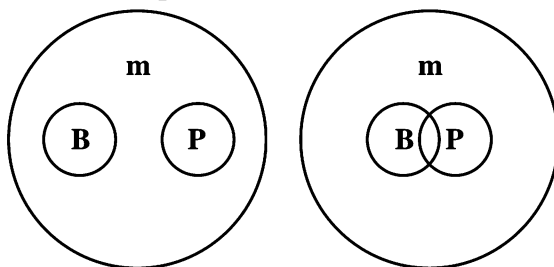


Fig. (a)

Fig. (b)

Conclusion 1 : Some pathogens are bacteria.

From fig. (a) conclusion 1 does not follow.

Conclusion 2 : All pathogens are not bacteria.

From possibility of case present in fig. (b) conclusion 2 does not follow.

By this option (D) is correct.

Here, both the conclusion are wrong by can't say condition as there is no direct relation given between variable pathogens and bacteria.

And variable of the conclusion are same.

Also one conclusion is positive and another is negative.

Therefore, they full fill the conditional case of "either-or"

By this option (C) is also correct.

Hence, correct options are (C) and (D).

2.28 (A)

Given : Statement 1 : All student are inquisitive.

Statement 2 : Some student are inquisitive

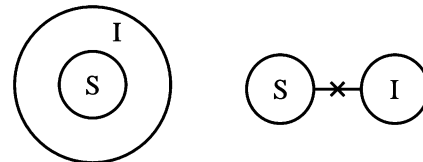
Statement 3 : No student are inquisitive.

Statement 4 : Some student are not inquisitive

For finding the statement which cannot be true, simultaneously, we will go through with all options,

According to option (A) :

Statement 1 and statement 3 cannot be true simultaneously.



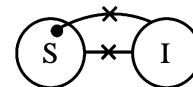
By the Venn diagram of the statement, we can say that statement 1 and statement 3 cannot be true simultaneously.

According to option (B) :

Statement 3 and Statement 4 cannot be true simultaneously.



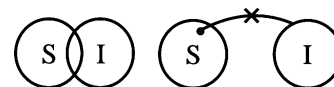
By the Venn diagram of the statements, we can say that both the statement can be true simultaneously by that diagram.



As when no student is inquisitive some students are also not inquisitive.

According to option (C) :

Statement 2 and statement 4 cannot be true simultaneously.



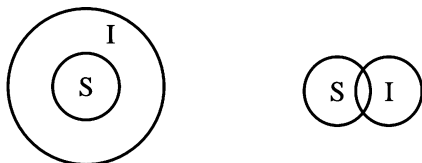
By the Venn diagram of the statements, we can say that both the statement can be true simultaneously by that diagram.



By this diagram it is possible at the same time some students are inquisitive and some students are not inquisitive.

According to option (D) :

Statement 1 and statement 2 cannot be true simultaneously.



By the Venn diagram of the statement, we can say that both the statement can be true simultaneously.

As, when all students are inquisitive then some students are already inquisitive.

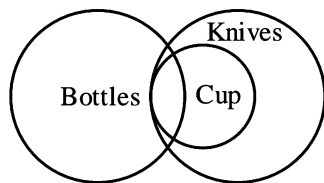
Hence, the correct option is (A).

2.29 (D)

Given : Statement I : Some bottles are cups

Statement II : All cups are knives

Below figure shows the Venn diagram according to the given statements,



Conclusion I : Some bottles are knives,

Is correct, as we can see in the diagram some part of the bottle is intersect with knives.

Conclusion II : Some knives are cups,

Is correct, as we can see in the diagram all part of the cup is intersect with knives.

Conclusion III : All cups are bottles,

Is not correct, as we can see in the diagram some part of the cup is intersect with bottle and we have no definite information about remaining part of cup.

Conclusion IV : All knives are cups,

Is not correct, as we can see in the diagram some part of the knives is intersect with cup and we have no definite information about remaining part of knives.

Hence, the correct option is (D).

2.30 (B)

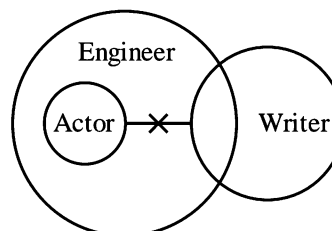
Given :

Statement 1 : Some engineers are writers.

Statement 2 : No writer is an actor.

Statement 3 : All actors are engineers.

Below figure shows the Venn diagram according to the given statements.



Conclusion I : Some writers are engineers.

Is definitely true as we can see in the diagram some part of engineer is intersected with writer.

Conclusion II : All engineer are actor.

Is definitely wrong as we can see in the diagram some part of engineer is intersected with writer which can never be part of actor.

Conclusion III : No actor is writer.

Is definitely true as we can see in the diagram no part of actor is intersected with writer.

Conclusion IV : Some actor are writer.

Is definitely wrong as we can see in the diagram no part of actor is intersected with writer.

So, only conclusion I and III follows.

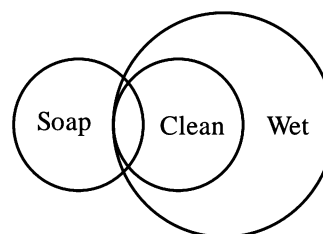
Hence, the correct option is (B).

2.31 (D)

Given : Statement 1 : Some soaps are clean.

Statement 2 : All clean objects are wet.

Below figure shows the Venn diagram according to the given statements,



Conclusion I : Some clean objects are soaps.

It can be inferred as we can see in the diagram some part of soap is intersected with clean.

Conclusion II : No clean objects is a soap.

It cannot be inferred as we can see in the diagram some part of soap is intersected with clean.

Conclusion III : Some wet object are soaps.

It can be inferred as we can see in the diagram some part of wet is intersected with soap.

Conclusion IV : All wet object are soaps.

It cannot be inferred as we can see in the diagram some part of wet is intersected with soap and we have no definite information about the remaining part of wet. So it can be part of soap or cannot be part of soap.

Hence, the correct option is (D).

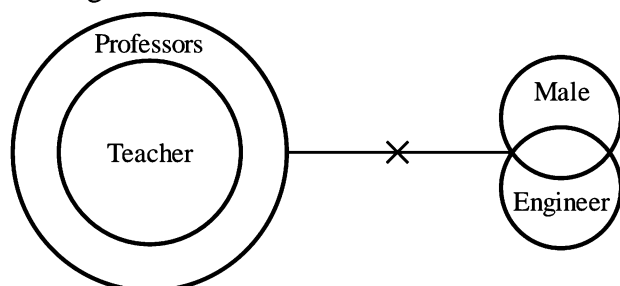
2.32 (A)

Given : Statement 1: All teachers are professors.

Statement 2: No professor is a male.

Statement 3: Some males are engineers.

Below figure shows the Venn diagram according to the given statements.



Conclusion I : No engineer is professor

As no information is provided for some part of engineers, they can be part of professors and cannot be part of professors.

Hence, it cannot be inferred from statement.

Conclusion II : Some engineers are professor.

As no information is provided for some part of engineers, they can be part of professors and cannot be part of professors.

Hence, it cannot be inferred from statement.

Conclusion III : No male is a teacher.

Can be inferred from statement as we can see in the diagram.

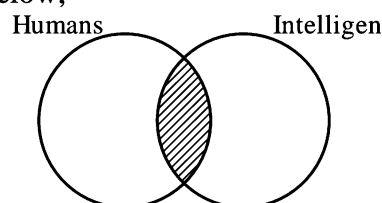
All part of teacher is inside of professors and no professor is male. Hence teachers are also not male.

Hence, the correct option is (A).

2.33 (D)

Given : Statement 'Some humans are intelligent'.

Can be represented by given venn diagram as shown below,



Option (A) No human is intelligent, is wrong as some human are intelligent.

Option (B) All humans are intelligent, is wrong as we have no information about remaining part of human.

Option (C) Some non-humans are intelligent, is wrong as we have no information about non-humans.

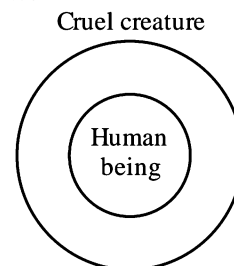
Option (D) Some intelligent beings are humans, can be inferred as some intelligent being are human can be seen in the diagram.

Hence, the correct option is (D)

2.34 (D)

Given : "Some human beings are not cruel creatures" is FALSE.

The venn diagram for the statement is shown in the figure below.



From this statement we can say that “All human beings are cruel creature”, according to this.

- (i) All human beings are cruel creatures, can be inferred with certainty.
- (ii) Some human beings are cruel creatures, can be inferred as if all is definite then some is also definite.
- (iii) Some creatures that are cruel are human beings, can be inferred as all human beings are cruel creature.
- (iv) No human beings are cruel creatures cannot be inferred as all human beings are cruel creature.

Hence, the correct option is (D).

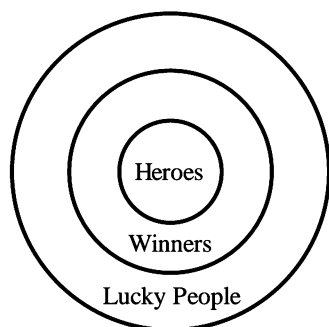
2.35 (B)

Given :

S1 : All heroes are winners.

S2 : All winners are lucky people.

According to the statement given in the question we can form Venn diagram as shown below,



From this Venn diagram inferences II and III can be logically deduced.

Hence, the correct option is (B).

2.36 (C)

The correct sequence is (C) SPRQ. It begins with the explanation (s) of the fortuitous geological event where a chunk of bedrock collided, followed by the geophysicists perspective (P) of the Himalayas as an active geological event then, it discusses the natural process of cooling (R) and

concludes with the impact on the earth's atmosphere (Q) . Providing a coherent flow of geological events.

Hence, the correct option is (C).

2.37 (D)

According to the given passage the (D) best suitable option will be option (D).

Hence, the correct option is (D).

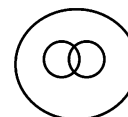
2.38 (B)

Column -I

(1) Animals, zebra, Giraffe

(i) Zebra and Giraffe are both animals.

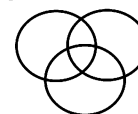
Venn-diagram :



(2) Director, producer, Actor

(ii) These professions can overlap (one person can be both a director and an actor, or a producer and an actor)

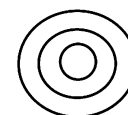
Venn - diagram:



(3) Word, Sentence, Novel

(iii) A word is a part of a sentence, and a sentence is a part of a Novel.

Venn-diagram:



(4) Pianist, Guitarist, Instrumentalist

(iv) A pianist and a guitarist are both types of instrumentalists

Venn-diagram:



Hence, the correct option is (B).

3.39 (D)

- **Class 5 :** Rishi (boy), Swathi (girl)
 - **Class 4 :** Pavan (boy), Tanvi (girl)
- First game :**
Only game with same class players →
Rishi vs Swathi
 - Girls won only 1 game :**
If Swathi wins Game 1 → girls already win 1.
Game 2 : Swathi vs Pavarn
If Swathi again → girls win 2 ✕ (not allowed)
So Pavan wins Game 2.
Game 3 : Pavan vs Tanvi
Girls must win 1 game, so Tanvi wins.
 - Winners**
 - Game 1 → Swathi
 - Game 2 → Pavan
 - Game 3 → Tanvi
 - Swathi never lost.

Hence, the correct option is (D).

3.40 (C)

Given statement:

'When it is raining, peacocks dance.'

This is a conditional statement.

Then contra positive is always true:

So, if peacocks are not dancing, then it is not raining.

Hence, the correct option is (C).

Engineering Services Examination (ESE)

1. (C)

Let the weight of R be x .

Then weight of S will be $2x$.

And weight of T will be $4x$.

And weight of Q will be $4.5x$.

And weight of P will be $9x$.

According to the question order of there weights will be,

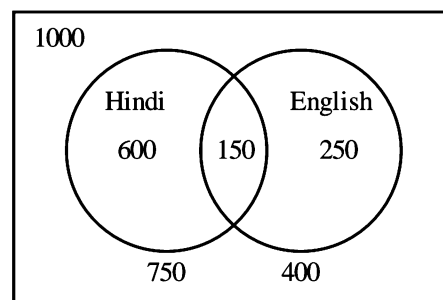
$$P > Q > T > S > R$$

According to this P and Q are heavier then T.

Hence, the correct option is (C).

2. (C)

According to the given data, Venn diagram can be drawn as shown below,



Only Hindi speaking,

$$1000 - (750 + 400) = 150$$

$$750 - 150 = 600$$

Hence, the correct option is (C).

3. (C)

Method 1

According to the question,

A is the smallest and D is the greatest. B is greatest than E , but less than C , that means, B is in the middle.

$$\Rightarrow D > C > B > E > A$$

Let the value of integer A is x .

$$\Rightarrow \text{Value of } E \text{ is } (x+4).$$

$$\Rightarrow \text{Value of } B \text{ is } (x+8).$$

⇒ Value of C is $(x+12)$.

⇒ Value of D will be $(x+16)$.

The sum of the integers is equal to E .

⇒ $A + B + C + D + E = E$

⇒ $x + (x+4) + (x+8) + (x+12) + (x+16) = (x+4)$

⇒ $4x = -36$

⇒ $x = -9$

So, $A = -9, E = -5, B = -1, C = 3, D = 7$

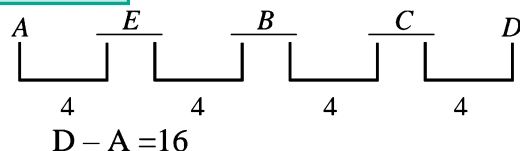
The positive difference between the lowest and the highest integers.

$$= (-9) - (+7) = (-16)$$

Positive difference will be 16.

Hence the correct option is (C).

Method 2



Hence, the correct option is (C).

4. (A)

Statement	Correctness	Reason
At least one girl has blue eyes.	Incorrect	This could be a probable situation but not sure as maybe both boys have blue eyes and both girls have brown eyes.
Two of the children are boys	Correct	This is a sure situation as among 4 children half are girls that mean the other half being 2 are boys.
The boys have brown eyes.	Incorrect	Probably but not sure as maybe both girls have

		brown eyes and both boys have blue eyes, or one girl and one boy have brown eyes.
--	--	---

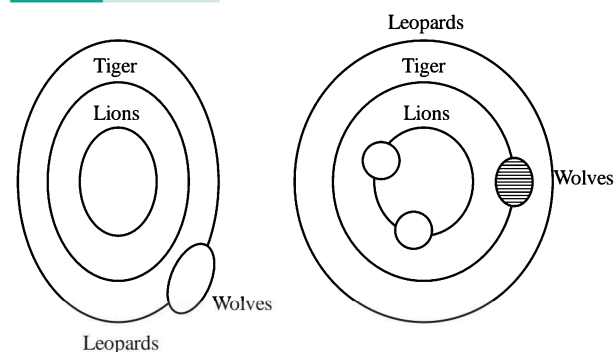
Hence, the correct option is (A).

5. (D)

After all switches were made, Max is directly behind the dog, James is alongside the dog on the left, Ruby is alongside the dog on the right, and Racheal is behind Max.

Hence the correct option is (D).

6. (C)

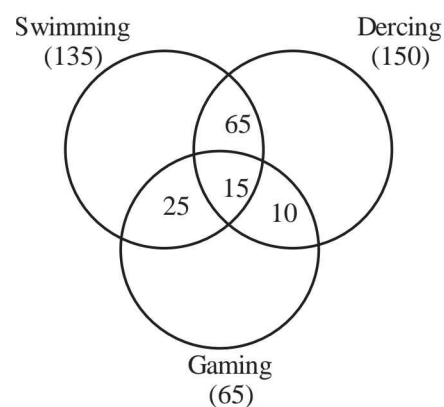


- (i) No mention of elephant.
- (ii) May or may not.
- (iii) Always follows.

Hence the correct option is (C).

7. (D)

According to Given data we will draw Venn-diagram



How many passengers like exactly two of the three type of Activities?

Exactly two of three type of Activities

$$= 25 + 65 + 10 = 100$$

Hence the correct option is (D).

8. (A)

Let us analyze the given statements one by one,

In terms of scores we have

$$V > P, P > Q \quad \text{i.e.} \quad V > P > Q$$

If R scores the Highest we have

$$R > \dots\dots\dots > T$$

If S Scores the Highest we have

$$S > \dots\dots\dots > U$$

If V ranks fifth. P and Q coming after

It will occupy sixth and seventh places respectively i.e. Q ranks least so S will score the Highest.

Hence the correct option is (A).



3

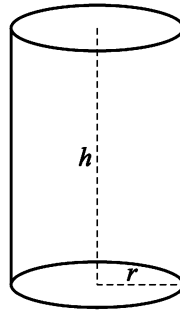
Numerical Computation

GEOMETRY :

1. Cylinder :

A cylinder is one of the most basic curved geometric shapes, with the surface formed by the points at a fixed distance from a given line segment, known as the axis of the cylinder.

A cylinder whose cross section is an ellipse, parabola, or hyperbola is called an elliptic cylinder, parabolic cylinder, or hyperbolic cylinder respectively.



A right circular cylinder

(i) Its volume is given by, $V = \pi r^2 h$

(ii) Without the top or bottom the surface area / curved surface area is given by,

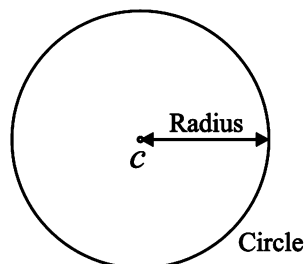
$$A = 2\pi r h$$

(iii) With the top and bottom, the surface area / total surface area is given by,

$$A = 2\pi r^2 + 2\pi r h = 2\pi r(r + h)$$

2. Circle :

Circle is a set of points in a plane that are equidistant to a given point, the center.



(i) Area of the circle $= \pi r^2$, where r is the radius of the circle

(ii) Circumference $= 2\pi.r$

(iii) Area of sector of a circle $= \frac{\theta}{360^\circ} \times \pi r^2$

where θ is the angle of the sector in degrees and r is the radius of the circle

(iv) Length of arc $= \frac{\theta}{360^\circ} \times 2\pi r$

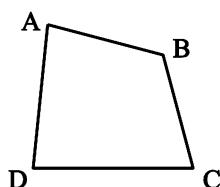
(v) Ring is the space enclosed by two concentric circles.

Area $= \pi R^2 - \pi r^2 = \pi(R+r)(R-r)$, where R is the radius of the outer circle and r is the radius of the inner circle

3. Quadrilaterals :

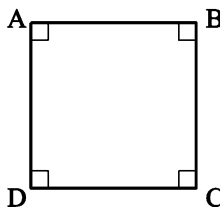
(i) Scalene or irregular quadrilateral

A quadrilateral without any special properties is called scalene quadrilateral. There is no symmetry and there are no lines parallel or perpendicular to each other.



(ii) Square (regular quadrilateral)

A square is a quadrilateral with four equal sides and four equal angles. The diagonals intersect perpendicularly and bisect each other and the diagonals are equally long.

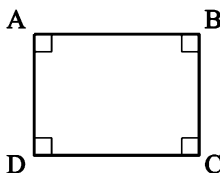


$$\text{Area} = (\text{one of the sides})^2$$

$$\text{Diagonal} = (\text{one of the sides}) \times \sqrt{2}$$

(iii) Rectangle :

It is a quadrilateral with four right angles (90°). In a rectangle the diagonals bisect each other and the diagonals are equally long.

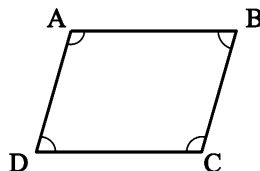


$$\text{Area} = \text{length} \times \text{width}$$

$$\text{Diagonal} = \sqrt{(\text{length})^2 + (\text{width})^2}$$

(iv) Parallelogram :

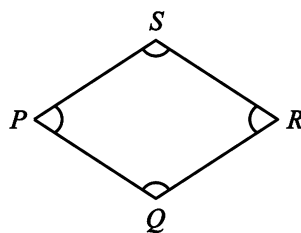
Quadrilateral with rotation symmetry is called parallelogram. It has two pairs of parallel lines. Its opposite sides are equal in length (and parallel). The opposite angles are equal in size and diagonals cut each other into two equal parts.



$$\text{Area} = \text{base} \times \text{height}$$

(v) Rhombus :

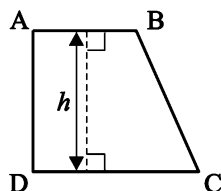
A rhombus is a quadrilateral with four equal sides, and both diagonals are axes of symmetry. The opposite angles are equal in size and diagonals intersect perpendicularly and bisect. The diagonals divide the angles into two equal parts



$$\text{Area} = \frac{1}{2}(PR \times QS)$$

(vi) Trapezium

It is a quadrilateral with one pair of parallel lines.

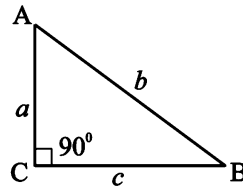


$$\text{Area} = \frac{1}{2}[(\text{length of small base} + \text{length of large base}) \times \text{height}]$$

$$A = \frac{1}{2}[(AB + CD) \times h]$$

4. Triangle :

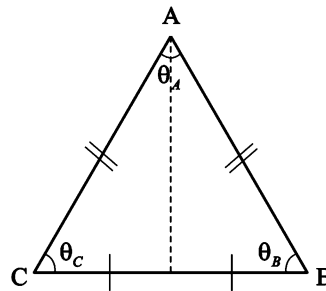
Triangle is a structure that has three sides. There are all kinds of triangles. The biggest group is of the irregular (or scalene) triangles. They do not have any special properties like a right angle or equal sides. These irregular triangles are divided into acute – angled triangles and into obtuse angled triangles.

(i) Right - angled triangle :

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$$

(ii) Isosceles triangle :

It is a triangle with two sides equal in length and because of this it has an axis of symmetry. The angle that intersects the axis of asymmetry is called the apex angle. The other two angles are called the base angles. The base angles have the same size.



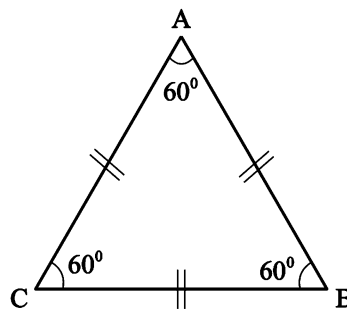
From figure,

$$AB = AC$$

$$\theta_B = \theta_C$$

(iii) Equilateral triangle :

It is a triangle with three equal sides. This triangle has three axes of symmetry. The three angles in this triangle are all 60° .



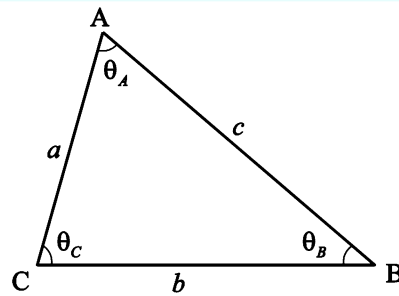
From figure,

$$AB = AC = BC$$

$$\theta_A = \theta_B = \theta_C$$

(iv) Acute - angled triangle :

It is a triangle with three acute angles.

**Important points :**

- (i) When the measurements of three sides a, b, c are given

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

where, $s = \frac{a+b+c}{2}$

This is called Heron's formula.

(ii) $\text{Area} = \frac{1}{2}ab \cdot \sin C = \frac{1}{2}bc \cdot \sin A = \frac{1}{2}ca \cdot \sin B$

- (iii) For an equilateral triangle

$$\text{Area} = \frac{\sqrt{3} \cdot a^2}{4} \text{ where 'a' is the side of the triangle}$$

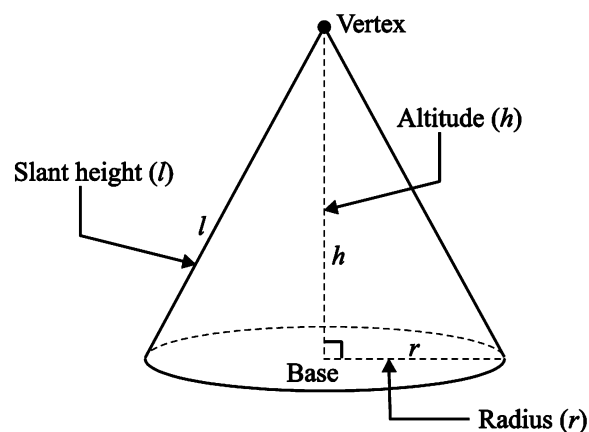
- (iv) For an isosceles triangle

$$\text{Area} = \frac{b}{4} \sqrt{4a^2 - b^2}$$

where 'a' is length of each of the two equal sides and b is the third side.

5. Cone :

A circular cone has a circular base, which is connected by a curved surface to its vertex. A right circular cone is a circular cone whose altitude intersects the plane of the circle at the circle's center. The slant height of a right circular cone is the distance from any point on the circle to the vertex of the cone.



- (i) Volume, $V = \frac{1}{3} \pi r^2 h$
- (ii) Slant height, $l = \sqrt{r^2 + h^2}$
- (iii) Lateral surface area, $L = \pi r l = \pi r \sqrt{r^2 + h^2}$
- (iv) Base surface area, $B = \pi r^2$
- (v) Total surface area, $A = L + B = \pi r l + \pi r^2 = \pi r(l + r) = \pi r(r + \sqrt{r^2 + h^2})$

6. Polygons :

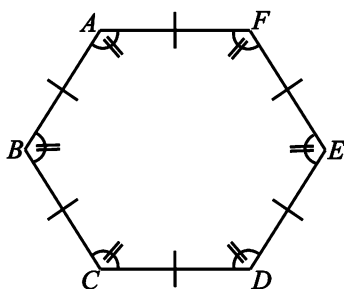
The polygons are two dimensional closed figure made up of straight lines. In other words, it is a closed shape in which each line segments intersects exactly at the end points.

Types of polygons :

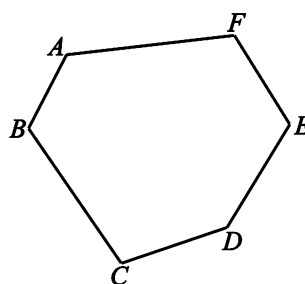
Polygons are classified based on their sides and angles.

(i) Regular and irregular polygons :

If all sides and angles are equal in a polygon, then the polygon is named as regular polygon otherwise it is known as an irregular polygon which is shown below.



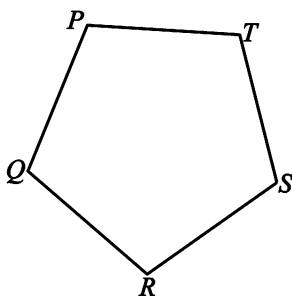
Regular polygon



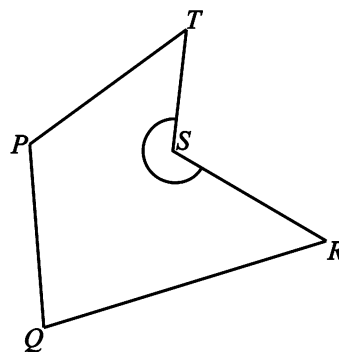
Irregular polygon

(ii) Concave and convex polygons :

If any internal angle of a polygon is greater than 180° , then it is known as a concave polygon. If none of the internal angles of a polygon is greater than 180° , then it is known as a convex polygon, which is shown below,



Convex polygon



Concave polygon

List of polygons :

Quadrilateral	4
Pentagon	5
Hexagon	6
Heptagon	7
Octagon	8
Nonagon	9
Decagon	10
Hendecagon	11
Dodecagon	12
Hectogon	100

Polygon Formulae :

(i) Sum of the interior angles of a polygon $= (N - 2) \times 180^\circ = (N - 2) \times 180^\circ$

(ii) The number of diagonals in polygon $= \frac{1}{2} N(N - 3)$

(iii) The number of triangles (When drawing all the diagonals from one vertex) in a polygon $= (N - 2)$.

(iv) The area can be determined by different formulas depending on the information given,

(a) Length of a side is given then area $= \frac{S^2 N}{4 \tan\left(\frac{\pi}{N}\right)}$

(b) Radius (circumradius) is given then area $= \frac{R^2 N \sin\left(\frac{2\pi}{N}\right)}{2}$

N = number of sides

7. Sphere and Hemisphere :

A sphere is a set of points in three dimensional space, equidistant from a point called the center of the sphere. The distance from the center to the points on the sphere is called the radius. The term “sphere” refers to the surface only. The interior of the sphere should be thought of as a ball. The surface area and volume of a sphere of radius R are given by,

(i) Surface area, $S = 4\pi R^2$

(ii) Volume, $V = \frac{4}{3} \pi R^3$

The equation of a sphere of radius R centered at the origin is $x^2 + y^2 + z^2 = R^2$. A sphere is divided into two equal hemispheres by any plane that passes through its center. The total surface area of a hemisphere is the sum of the area of half the sphere and the area of the circle,

$$S = \frac{1}{2} (4\pi R^2) + \pi R^2 = 3\pi R^2$$

8. Cube :

A right prism whose base is a square and height is equal to the side of the base is called a cube.

(i) Volume = a^3 where a is the edge of the cube

(ii) Lateral surface area = $4a^2$

(iii) Total surface area = $6a^2$

(iv) The longest diagonal of the cube i.e. the line joining one vertex on the top face to the diagonally opposite vertex on the bottom face is called the diagonal of the cube. The length of the diagonal of the cube is $a\sqrt{3}$.

POLYNOMIALS :

Let $a_0, a_1, a_2, \dots, a_n$ be real numbers and x is a real variable. Then $f(x) = a_0 + a_1x + a_2x^2 + \dots + a_nx^n$ is called a real polynomial of real variable x with coefficients $a_0, a_1, a_2, \dots, a_n$.

1. Degree of a Polynomial :

Degree of a polynomial is the highest power of the variable in the polynomial.

2. Remainder theorem :

If any polynomial $f(x)$ is divided by $(x-a)$ then $f(a)$ is the remainder.

For example, $f(x) = x^2 - 5x + 7 = 0$ is divided by $x - 2$.

$$R = f(2) = 2^2 - 5 \times 2 + 7 = 1$$

3. Factor Theorem :

If $(x-a)$ is a factor of $f(x)$, then remainder $f(a) = 0$. In other words, if $f(a) = 0$, then $(x-a)$ is a factor of $f(x)$,

For example,

When $f(x) = x^2 - 5x + 6 = 0$ is divided by $x - 2$, the remainder $f(2)$ is zero which shows that $x - 2$ is the factor of $f(x)$.

4. Root or Zero of a polynomial equation :

If $f(x) = 0$ is a polynomial equation and $f(\alpha) = 0$, then α is called a root or zero of the polynomial equation $f(x) = 0$.

5. Linear equation with two variables :

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

These equations can be

(i) Inconsistent means have no solution if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

(ii) Consistent and has infinitely many solutions if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

(iii) Consistent and have unique solution if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

(a) Quadratic Equation :

Quadratic equation in “x” is one in which the highest power of “x” is 2. The equation is generally satisfied by two values of “x”.

The quadratic form is generally represented by $ax^2 + bx + c = 0$ where $a \neq 0$ and a, b, c are constants.

A quadratic equation in one variable has two and only two roots, which are

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

and
$$x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

(b) Nature of Roots :

The two roots of any quadratic equation always depend on the value of $b^2 - 4ac$ called discriminant (D).

$D > 0$; Real and unequal roots

$D = 0$; Real and equal

$D < 0$; Imaginary and unequal

(c) Sum and Product of roots :

If α and β are the two roots of $ax^2 + bx + c = 0$,

$$\text{Then sum of roots} = \alpha + \beta = -\frac{b}{a} = -\frac{(\text{coefficient of } x)}{(\text{coefficient of } x^2)}$$

$$\text{And product of roots} = \alpha\beta = \frac{c}{a} = \frac{\text{Constant}}{\text{coefficient of } x^2}$$

(d) Formation of equation from roots :

If α and β are the roots of any quadratic equation then that equation can be written in the form $x^2 - (\alpha + \beta)x + \alpha\beta = 0$

i.e. $x^2 - (\text{sum of the roots})x + \text{Product of the roots} = 0$.

(e) Maximum and Minimum value of a Quadratic equation :

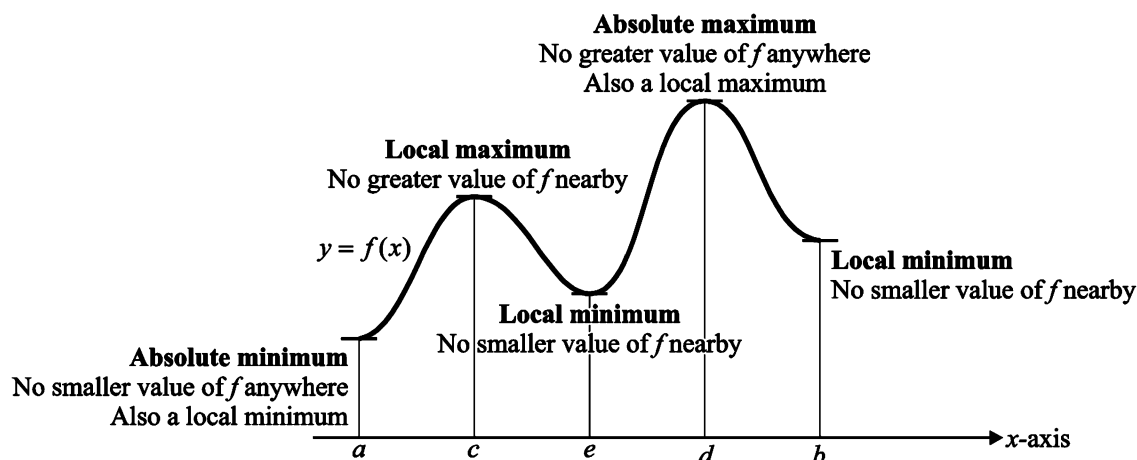
The quadratic equation $ax^2 + bx + c = 0$ will have maximum value at $x = -\frac{b}{2a}$. If $a < 0$, it has maximum value and if $a > 0$, it has minimum value.

The maximum or minimum value are given by,

$$\frac{4ac - b^2}{4a}$$

MAXIMA AND MINIMA :

1. **Introduction :** In Mathematics, the maximum and minimum (maximums or maxima and minimums or minima) of a function, known collectively as extrema (extremum) are the **largest** and **smallest value** that the function takes at a point either within a given neighbourhood (local or relative extremum) or on the function domain in its entirety (global or absolute extremum). Extremum is the term used for both maximum and minimum.



2. **Maxima and Minima for Function of One Independent Variable**

To find maxima and minima of a function $y = f(x)$, follow these steps

Step 1 : Find $\frac{dy}{dx}$, and put $\frac{dy}{dx} = 0$ find the value of x and this value is said to be the stationary point, this is the necessary condition to find extremum value of function.

Step 2 : Find $\frac{d^2y}{dx^2}$ and check the value at the stationary point obtained in step 1.

(i) A function $f(x)$ has a maxima at $x = a$ if $f'(a) = 0$ and $f''(a) < 0$.

(ii) A function $f(x)$ has a minima at $x = a$ if $f'(a) = 0$ and $f''(a) > 0$.

(iii) A function $f(x)$ has no maxima and minima at $x = a$ if $f'(a) = 0$ and $f''(a) = 0$.

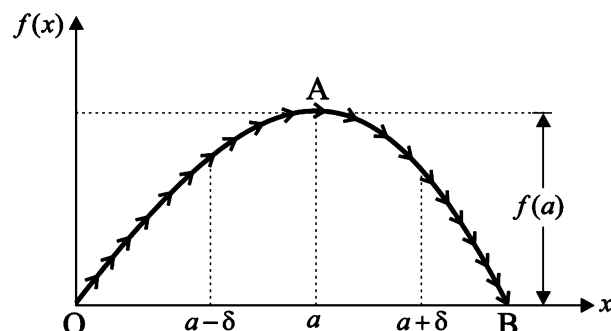
Key Point

Stationary points : For a continuous and differentiable function $f(x)$, the values of x for which the slope of the function $f'(x) = 0$ are called stationary points or turning points or critical points. These are the points of x in the domain where $f'(x) = 0$.

Saddle point : A point where function is neither maximum nor minimum is said to be a **saddle point**. At such point function is maximum in one direction while minimum in another direction.

LOCAL OR RELATIVE MAXIMA AND MINIMA :**1. Local Maxima :**

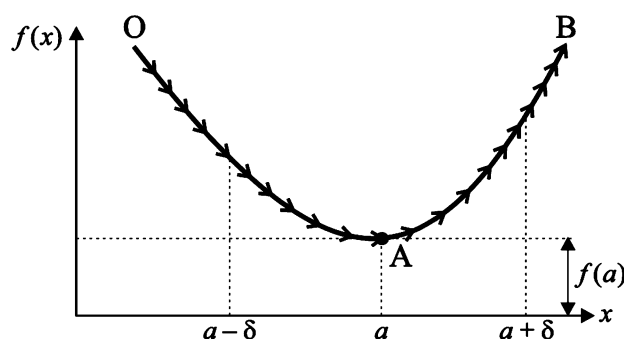
A function $f(x)$ has a maximum at $x = a$ if there exists some interval $(a - \delta, a + \delta)$ around 'a' such that $f(a) \geq f(x)$ for all x in $(a - \delta, a + \delta)$.



OA = Increasing Function, A = Stationary Point, AB = Decreasing Function

2. Local Minima :

A function $f(x)$ has a minimum at $x = a$ if there exists some interval $(a - \delta, a + \delta)$ around 'a' such that $f(a) \leq f(x)$ for all values of x in $(a - \delta, a + \delta)$.



OA = Decreasing function, A = Stationary Point, AB = Increasing Function

STEPS TO FIND ABSOLUTE MAXIMUM AND MINIMUM VALUE OF THE FUNCTION IN THE INTERVAL [A, B] :

To find the absolute value or maximum and minimum value of the function follow the steps given below,

Step 1 : Find stationary points by putting $f'(x) = 0$.

Step 2 : Find the value of $f(x)$ at stationary points.

Step 3 : Also find $f(a)$ and $f(b)$.

Then the maximum of the value is the absolute maximum of the given function $f(x)$ and minimum of these values is the absolute minimum of the given function $f(x)$.

Key Point

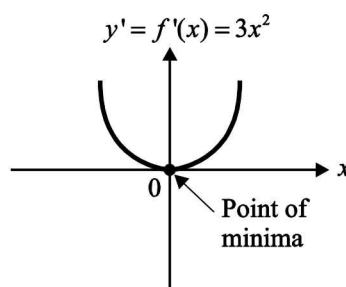
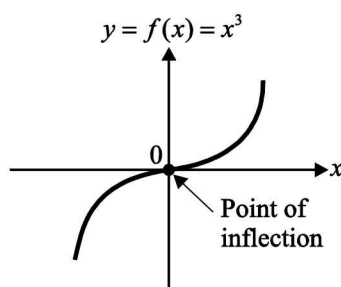
Convexity and Concavity of a Curve

- (i) If $f''(x) < 0$, $x \in (a, b)$ then the curve $y = f(x)$ is convex upward or concave downward in (a, b) .
- (ii) If $f''(x) > 0$, $x \in (a, b)$ then the curve $y = f(x)$ is concave upward or convex downward in (a, b) .

Point of inflection :

An inflection point is a point on a curve at which the sign of the curvature (i.e. the concavity) changes. An inflection point does not have to be a stationary point, but if it is, then it would also be a saddle point.

A function f (or the curve $y = f(x)$) has a point of inflection at $x = c$ if $f'(c) = 0$, $f''(c) = 0$ and $f'''(c) \neq 0$.



1. Maxima and Minima for Function of Two Independent Variables

To find maxima and minima of a function $z = f(x, y)$, follow these steps

Step 1 : Find $\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}$

Step 2 : Solve $\frac{df}{dx} = 0$ and $\frac{df}{dy} = 0$ to get stationary points.

Step 3 : Find the values of

$$r = \frac{\partial^2 f}{\partial x^2}, s = \frac{\partial^2 f}{\partial x \partial y}, t = \frac{\partial^2 f}{\partial y^2}$$

Step 4 : Check the conditions

If $rt - s^2 > 0, r > 0$	then it gives minima
$rt - s^2 > 0, r < 0$	then it gives maxima
$rt - s^2 = 0$	then we need further investigation required
$rt - s^2 < 0$	then neither maxima nor minima

2. Increasing and Decreasing Function (Monotonic Functions)

The word monotonic indicates the monotonous behavior i.e. in the sense of ascending (increasing) or descending (decreasing).

There are two types of monotonic function :

1. **Increasing function** : It can be further studied under two sub-topics.

(i) **Increasing function or non-decreasing function** : A function $f(x)$ is said to be **increasing** on an open interval (a, b) , if $f(x)$ increases as x increases in the open interval (a, b) .

$$\text{i.e., } x_1 < x_2 \Rightarrow f(x_1) \leq f(x_2) \quad \text{for all } x_1, x_2 \in (a, b)$$

(ii) **Strictly increasing function** : A function $f(x)$ is said to be **strictly increasing** on an open interval (a, b) if,

$$x_1 < x_2 \Rightarrow f(x_1) < f(x_2) \quad \text{for all } x_1, x_2 \in (a, b)$$

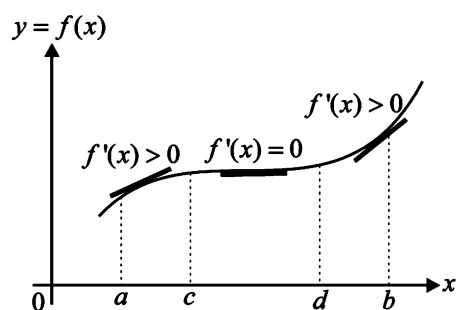
2. **Decreasing function** : It can be further divided into two sub-topics :

(i) **Decreasing function or non-increasing function** : A function $f(x)$ is said to be **decreasing** on an open interval (a, b) , if $f(x)$ decreases as x increases in the open interval (a, b) .

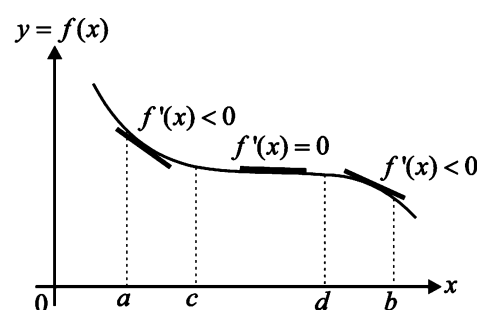
$$\text{i.e., } x_1 < x_2 \Rightarrow f(x_1) \geq f(x_2) \quad \text{for all } x_1, x_2 \in (a, b)$$

(ii) **Strictly decreasing function** : A function, $f(x)$ is said to be **strictly decreasing** on an open interval (a, b) if,

$$x_1 < x_2 \Rightarrow f(x_1) > f(x_2) \quad \text{for all } x_1, x_2 \in (a, b)$$



Interval	Monotonicity of $f(x)$
(a, b)	Increasing
(a, c)	Strictly increasing
(d, b)	Strictly increasing



Interval	Monotonicity of $f(x)$
(a, b)	Decreasing
(a, c)	Strictly decreasing
(d, b)	Strictly decreasing

Test for Increasing and Decreasing Functions

Let $f(x)$ be continuous on closed interval $[a, b]$ i.e. $a \leq x \leq b$ and differentiable on the open interval (a, b) i.e. $a < x < b$. Then if,

1. $f'(x) \geq 0$ for all $x \in (a, b)$ then $f(x)$ is increasing on $[a, b]$
2. $f'(x) > 0$ for all $x \in (a, b)$ then $f(x)$ is strictly increasing on $[a, b]$.
3. $f'(x) \leq 0$ for all $x \in (a, b)$ then $f(x)$ is decreasing on $[a, b]$.
4. $f'(x) < 0$ for all $x \in (a, b)$ then $f(x)$ is strictly decreasing on $[a, b]$.

Example 1

The curved surface area of a cylindrical pillar is 616 m^2 and its volume is 2156 m^3 . Find the ratio of its diameter to its height.

Solution :

Given :

(i) Volume of a cylindrical pillar $= \pi r^2 h = 2156 \text{ m}^3$

(ii) Curved surface area of a cylindrical pillar $= 2\pi r h = 616 \text{ m}^2$

According to given condition,

$$\frac{\pi r^2 h}{2\pi r h} = \frac{2156}{616}$$

So, radius, $r = 7 \text{ m}$

$$2\pi r h = 616$$

$$2 \times \frac{22}{7} \times 7 \times h = 616$$

So, height $h = 14$

Ratio : $\frac{2r}{h} = \frac{14}{14} = \frac{1}{1}$

Hence, the ratio of its diameter to its height is 1 : 1.

Example 2

Find the area of a circle whose radius is equal to the side of an equilateral triangle of area $9\sqrt{3} \text{ cm}^2$ (find approximate area)

Solution :

Given : Area of an equilateral triangle is $= 9\sqrt{3} \text{ cm}^2$

Area of equilateral $\Delta = \frac{\sqrt{3}}{4} \times x^2$

Where, $x = \text{side of triangle}$

$$\frac{\sqrt{3}}{4} \times x^2 = 9\sqrt{3}$$

$$x^2 = 36$$

$$x = 6 \text{ cm}$$

area of circle $= \pi r^2$ (where, $r = x$)

$$\pi \times 6^2 = 113.04 \text{ cm}^2$$

Hence, the area of a circle is 113.04 cm^2 .



2010 IIT Guwahati

3.1 Consider the function

$f(x) = \max(7-x, x+3)$. In which range does $f(x)$ take its minimum value?

[TF]

- (A) $-6 \leq x < -2$ (B) $-2 \leq x < 2$
(C) $2 \leq x < 6$ (D) $6 \leq x < 10$

3.2 Given the following four functions

$f_1(n) = n^{100}$, $f_2(n) = (1.2)^n$, $f_3(n) = 2^{n/2}$,
 $f_4(n) = 3^{n/3}$. Which function will have

the largest value for sufficiently large values of n (i.e. $n \rightarrow \infty$)? [MN]

- (A) f_4 (B) f_3
(C) f_2 (D) f_1

2011 IIT Madras

3.3 The number of solutions for the following system of inequalities is

$$X_1 \geq 0$$

$$X_2 \geq 0$$

$$X_1 + X_2 \leq 10$$

$$2X_1 + 2X_2 \geq 22$$
 [GG, TF]

- (A) 0 (B) infinite
(C) 1 (D) 2

3.4 If $(2y+1)/(y+2) < 1$, then which of the following alternatives gives the CORRECT range of y ? [AE, MN]

- (A) $-2 < y < 2$ (B) $-2 < y < 1$
(C) $-3 < y < 1$ (D) $-4 < y < 1$

3.5 A student attempted to solve a quadratic equation in 'x' twice. However, in the first attempt, he incorrectly wrote the constant term and ended up with the roots as (4, 3). In the second attempt, he

incorrectly wrote down the coefficient of x and got the roots as (3, 2). Based on the above information, the roots of the correct quadratic equation are:

[AE, MN]

- (A) $(-3, 4)$ (B) $(3, -4)$
(C) $(6, 1)$ (D) $(4, 2)$

3.6 Given that $f(y) = |y|/y$, and q is any non-zero real number, the value of $|f(q) - f(-q)|$ is [AG, CY, EC, EE, IN, MA, MT, XE, XL]

- (A) 0 (B) -1
(C) 1 (D) 2

3.7 If $\log(P) = \left(\frac{1}{2}\right) \log(Q) = \left(\frac{1}{3}\right) \log(R)$ then which of the following option is TRUE?

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) $P^2 = Q^3 R^2$ (B) $Q^2 = PR$
(C) $Q^2 = R^3 P$ (D) $R = P^2 Q^2$

3.8 The variable cost (V) of manufacturing a product varies according to the equation $V = 4q$, where q is the quantity produced. The fixed cost (F) of production of same product reduces with q according to the equation $F = 100/q$. How many units should be produced to minimize the total cost ($V + F$)?

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) 5 (B) 4
(C) 7 (D) 6

2012 IIT Delhi

3.9 The cost function for a product in a firm is given by $5q^2$, where q is the amount of production. The firm can sell the product at a market price of Rs. 50 per unit. The number of units to

produced by the firm such that the profit is maximized is

[BT, CE, CH, CS, ME, PH, PI]

- (A) 5 (B) 10
(C) 15 (D) 25

- 3.10 A political party orders an arch for the entrance to the ground in which the annual convention is being held. The profile of the arch follows the equation $y = 2x - 0.1x^2$, where y is the height of the arch in meters. The maximum possible height of the arch is

[BT, CE, CH, CS, ME, PH, PI]

- (A) 8 meters (B) 10 meters
(C) 12 meters (D) 14 meters

- 3.11 Which of the following assertions are CORRECT?

[BT, CE, CH, CS, ME, PH, PI]

P : Adding 7 to each entry in a list adds 7 to the mean of the list

Q : Adding 7 to each entry in a list adds 7 to the standard deviation of the list

R : Doubling each entry in a list doubles the mean of the list

S : Doubling each entry in a list leaves the standard deviation of the list unchanged

- (A) P, Q (B) Q, R
(C) P, R (D) R, S

- 3.12 Let $f(x) = x - [x]$, where $x \geq 0$ and $[x]$ is the greatest integer not larger than x . Then $f(x)$ is a : [AR, GG, TF]

- (A) monotonically increasing function
(B) monotonically decreasing function
(C) linearly increasing function between two integers
(D) linearly decreasing function between two integers

- 3.13 Two points $(4, p)$ and $(0, q)$ lie on a straight line having a slope of $3/4$. The value of $(p - q)$ is [AE, AG, MN]

- (A) -3 (B) 0
(C) 3 (D) 4

2013 IIT Bombay

- 3.14 The set of values of p for which the roots of the equation $3x^2 + 2x + p(p-1) = 0$ are of opposite sign is [EC, EE, IN]

- (A) $(-\infty, 0)$ (B) $(0, 1)$
(C) $(1, \infty)$ (D) $(0, \infty)$

- 3.15 If $3 \leq X \leq 5$ and $8 \leq Y \leq 11$ then which of the following options is TRUE?

[AE, AG, BT, CH, CY, MN, XE, XL]

- (A) $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{5}$ (B) $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{5}{8}$
(C) $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{8}{5}$ (D) $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{11}$

- 3.16 If $|-2X + 9| = 3$ then the possible value of $|-X| - X^2$ would be

[AE, AG, BT, CH, CY, MN, XE, XL]

- (A) 30 (B) -30
(C) -42 (D) 42

- 3.17 X and Y are two positive real numbers such that $2X + Y \leq 6$ and $X + 2Y \leq 8$. For which of the following values of (X, Y) , the function $f(x, y) = 3X + 6Y$ will give maximum value?

[AR, CE, GG, MA, MT, PH, TF]

- (A) $\left(\frac{4}{3}, \frac{10}{3}\right)$ (B) $\left(\frac{8}{3}, \frac{20}{3}\right)$
(C) $\left(\frac{8}{3}, \frac{10}{3}\right)$ (D) $\left(\frac{4}{3}, \frac{20}{3}\right)$

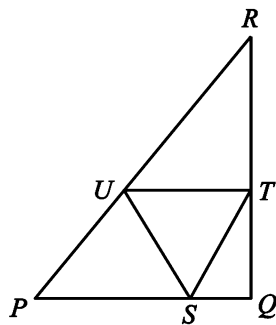
- 3.18 If $|4X - 7| = 5$ then the values of $2|X| - |-X|$ is

[AR, CE, GG, MA, MT, PH, TF]

- (A) $2, \frac{1}{3}$ (B) $\frac{1}{2}, 3$
(C) $\frac{3}{2}, 9$ (D) $\frac{2}{3}, 9$

2014 IIT Kharagpur

- 3.19** In the given figure angle Q is a right angle, $PS : QS = 3 : 1$, $RT : QT = 5 : 2$ and $PU : UR = 1 : 1$. If area of triangle QTS is 20 cm^2 , then the area of triangle PQR in cm^2 is _____. [AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]



- 3.20** Let $f(x, y) = x^n y^m = P$. If x is doubled and y is half, the new value of f is

[EC-4, ME-4]

- (A) $2^{n-m}P$ (B) $2^{m-n}P$
 (C) $2(n-m)P$ (D) $2(m-n)P$
- 3.21** The roots of $ax^2 + bx + c = 0$ are real and positive. a, b and c are real. Then $ax^2 + b|x| + c = 0$ has [CS-1, EE-1]
- (A) No roots (B) 2 real roots
 (C) 3 real roots (D) 4 real roots
- 3.22** When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines? _____.

[CS-1, EE-1]

- 3.23** If x is real and $|x^2 - 2x + 3| = 11$, then possible values of $|-x^3 + x^2 - x|$ include

[CS-2, EE-2]

- (A) 2, 4 (B) 2, 14
 (C) 4, 52 (D) 14, 52

- 3.24** If $y = 5x^2 + 3$, then the tangent at $x = 0, y = 3$ [AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

- (A) Passes through $x = 0, y = 0$
 (B) Has a slope of $+1$
 (C) Is parallel to the x -axis
 (D) Has a slope of -1

- 3.25** The smallest angle of a triangle is equal to two thirds of the smallest angle of a quadrilateral. The ratio between the angles of the quadrilateral is 3:4:5:6. The largest angle of the triangle is twice its smallest angle. What is the sum, in degrees, of the second largest angle of the triangle and the largest angle of the quadrilateral? [AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

2015 IIT Kanpur

- 3.26** Consider a function $f(x) = 1 - |x|$ in $-1 \leq x \leq 1$. The value of x at which the function attains a maximum, and the maximum value of the function are :

[CS-2, EE-2]

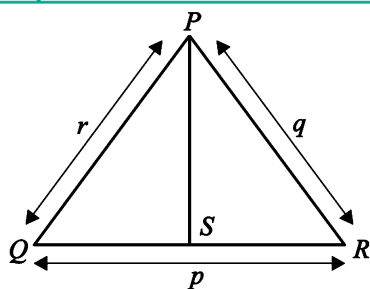
- (A) 0, -1 (B) $-1, 0$
 (C) 0, 1 (D) $-1, 2$

- 3.27** If p, q, r, s are distinct integers such that
 $f(p, q, r, s) = \max(p, q, r, s)$
 $g(p, q, r, s) = \min(p, q, r, s)$
 $h(p, q, r, s) = \text{remainder of } (p \times q) / (r \times s) \text{ if } (p \times q) > (r \times s) \text{ or remainder of } (r \times s) / (p \times q) \text{ if } (r \times s) > (p \times q)$

Also a function $fgh(p, q, r, s) = f(p, q, r, s) \times g(p, q, r, s) \times h(p, q, r, s)$

Also the same operations are valid with two variable function of the form $f(p, q)$. What is the value of $fgh(h(2, 5, 7, 3), 4, 6, 8)$? [CS-2, EE-2]

- 3.28** In a triangle PQR , PS is the angle bisector of $\angle QPR$ and $\angle QPS = 60^\circ$. What is the length of PS ? [CS-2, EE-2]

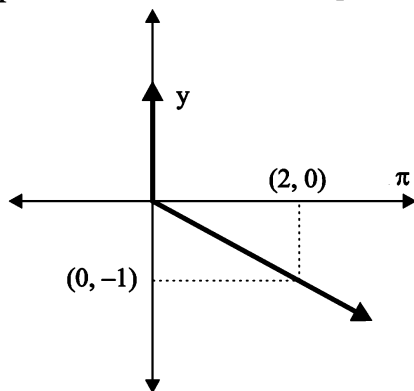


- (A) $\frac{(q+r)}{qr}$ (B) $\frac{qr}{(q+r)}$
 (C) $\sqrt{(q^2 + r^2)}$ (D) $\frac{(q+r)^2}{qr}$

- 3.29** Right triangle PQR is to be constructed in the xy -plane so that the right angle is at P and line PR is parallel to the x -axis. The x and y coordinates of P , Q , and R are to be integers that satisfy the inequalities : $-4 \leq x \leq 5$ and $6 \leq y \leq 16$. How many different triangles could be constructed with these properties?

[AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]

- (A) 110 (B) 1,100
 (C) 9,900 (D) 10,000
- 3.30** A function $f(x)$ is linear and has a value of 29 at $x = -2$ and 39 at $x = 3$. Find its value at $x = 5$. [CE-1, CS-3]
 (A) 59 (B) 45
 (C) 43 (D) 35
- 3.31** Choose the most appropriate equation for the function drawn as a thick line, in the plot below. [CE-1, CS-3]



- (A) $x = y - |y|$ (B) $x = -(y - |y|)$
 (C) $x = y + |y|$ (D) $x = -(y + |y|)$

2016 IISc Bangalore

- 3.32** In a quadratic function, the value of the product of the roots (α, β) is 4. Find the value of

$$\frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}} \quad \text{[CS-2, EE-1]}$$

- (A) n^4 (B) 4^n
 (C) 2^{2n-1} (D) 4^{n-1}

- 3.33** A wire of length 340 mm is to be cut into two parts. One of the parts is to be made into a square and the other into a rectangle where sides are in the ratio of 1 : 2. What is the length of the side of the square (in mm) such that the combined area of the square and the rectangle is a MINIMUM? [EC-2, ME-3]

- (A) 30 (B) 40
 (C) 120 (D) 180

- 3.34** Find the area bounded by the lines $3x + 2y = 14$, $2x - 3y = 5$ in the first quadrant. [AR, CY, EC-3, IN, MA, PE]

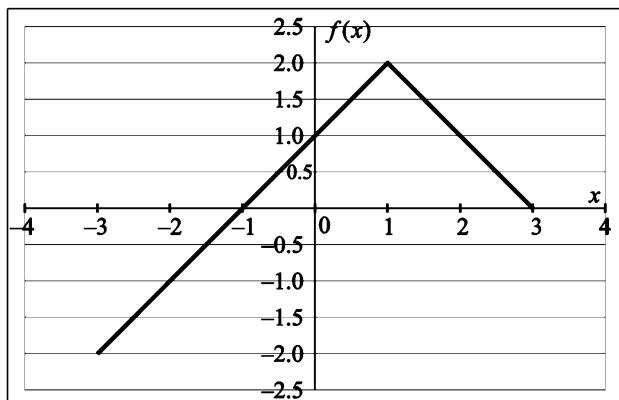
- (A) 14.95
 (B) 15.25
 (C) 15.70
 (D) 20.35

- 3.35** A straight line is fit to a data set $(\ln x, y)$. This line intercepts the abscissa at $\ln x = 0.1$ and has a slope of -0.02 . What is the value of y at $x = 5$ from the fit?

[AR, CY, EC-3, IN, MA, PE]

- (A) -0.030
 (B) -0.014
 (C) 0.014
 (D) 0.030

3.36



Choose the correct expression for $f(x)$ given in the graph. [CS-2, EE-1]

- (A) $f(x) = 1 - |x - 1|$
 (B) $f(x) = 1 + |x - 1|$
 (C) $f(x) = 2 - |x - 1|$
 (D) $f(x) = 2 + |x - 1|$

3.37 A cube is built using 64 cubic blocks of side and unit. After it is built, one cubic block is removed from every corner of the cube. The resulting surface area of the body (in square units) after the removal is _____. [CE-1, CS-1]

- (A) 56 (B) 64
 (C) 72 (D) 96

3.38 If $f(x) = 2x^7 + 3x - 5$, which of the following is a factor of $f(x)$? [CE-1, CS-1]

- (A) $(x^3 + 8)$ (B) $(x - 1)$
 (C) $(2x - 5)$ (D) $(x + 1)$

3.39 In a process, the number of cycles of failure decreases exponentially with an increase in load. At a load of 80 units, it takes 100 cycles of failure. When the load is halved, it takes 10000 cycles for failure. The load for which the failure will happen in 5000 cycles is _____. [CE-1, CS-1]

- (A) 40.00 (B) 46.02
 (C) 60.01 (D) 92.02

3.40 A square pyramid has a base perimeter x and the slant height is half of the perimeter. What is the lateral surface area of the pyramid? [AG, CE-2, EY, MT, PI]

- (A) x^2 (B) $0.75x^2$
 (C) $0.50x^2$ (D) $0.25x^2$

3.41 A window is made up of a square portion and an equilateral triangle portion above it. The base of the triangular portion coincides with the upper side of the square. If the perimeter of the window is 6 m, the area of the window in m^2 is _____. [BT, CH, GG, ME-2, MN, PH]

- (A) 1.43 (B) 2.06
 (C) 2.68 (D) 2.88

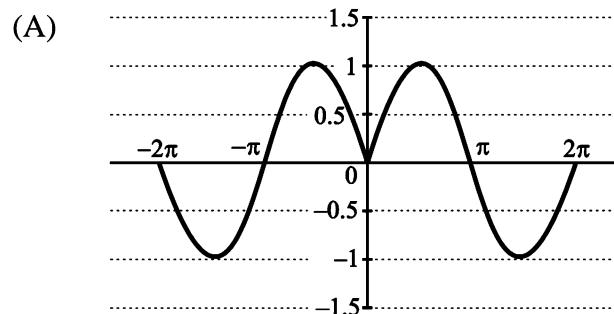
3.42 The binary operation $\square$ is defined as $a \square b = ab + (a + b)$, where a and b are any two real numbers. The value of the identity element of this operation, defined as the number x such that $a \square x = a$, for any a , is _____. [BT, CH, GG, ME-2, MN, PH]

- (A) 0 (B) 1
 (C) 2 (D) 10

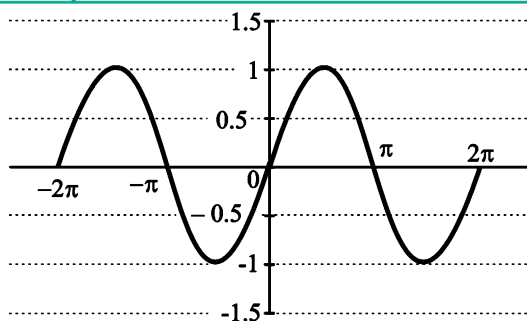
3.43 Which of the following curves represents the function $y = \ln \left\{ e^{\sin(|x|)} \right\}$ for $|x| < 2\pi$?

Here, x represents the abscissa and y represents the ordinate.

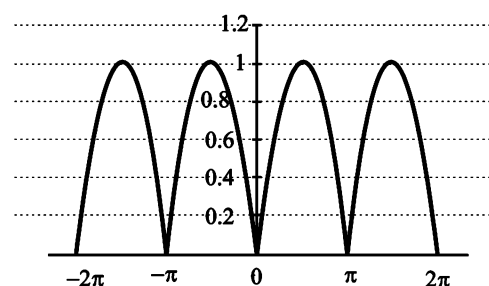
[BT, CH, GG, ME-2, MN, PH]



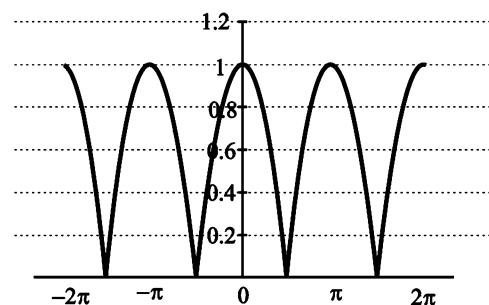
(B)



(C)



(D)



2017 IIT Roorkee

3.44 The expression $\frac{(x+y)-|x-y|}{2}$ is equal

to [CS-1, EE-1]

- (A) the maximum of x and y
 (B) the minimum of x and y
 (C) 1
 (D) None of the above

3.45 The number of roots of $e^x + 0.5x^2 - 2 = 0$ in the range $[-5, 5]$ is [CS-2, EE-2]

- (A) 0 (B) 1
 (C) 2 (D) 3

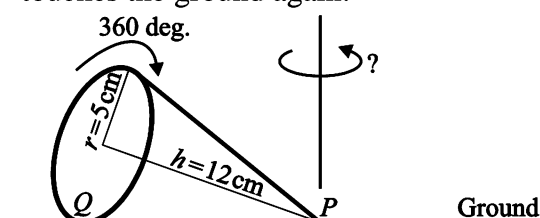
3.46 The following sequences of number is arranged in increasing order :
 1, x , x , x , y , y , 9, 16, 18, given that the

mean and median are equal, and are also equal to twice the mode, the value of y is

[CE-1, CH, MN]

- (A) 5 (B) 6
 (C) 7 (D) 8

3.47 A right-angled cone (with base radius 5 cm and height 12 cm), as shown in the figure below, is rolled on the ground keeping the point P fixed until the point Q (at the base of the cone, as shown) touches the ground again.



By what angle (in radians) about P does the cone travel? [AR, ME-1, TF]

- (A) $\frac{5\pi}{12}$ (B) $\frac{5\pi}{24}$
 (C) $\frac{24\pi}{5}$ (D) $\frac{10\pi}{13}$

3.48 In a company with 100 employees, 45 earn Rs. 20,000 per month, 25 earn Rs. 30,000, 20 earn Rs. 40,000, 8 earn Rs. 60,000, and 2 earn Rs. 150,000. The median of the salaries is

[AR, ME-1, TF]

- (A) Rs. 20,000 (B) Rs. 30,000
 (C) Rs. 32,300 (D) Rs. 40,000

3.49 Let S_1 be the plane figure consisting of the points (x, y) given by the inequalities $|x-1| \leq 2$ and $|y+2| \leq 3$. Let S_2 be the plane figure given by the inequalities $x-y \geq -2$, $y \geq 1$ and $x \leq 3$. Let S be the union of S_1 and S_2 . The area of S is

[AR, ME-1, TF]

- (A) 26 (B) 28
 (C) 32 (D) 34

2018 IIT Guwahati

- 3.50 Functions $F(a, b)$ and $G(a, b)$ are defined as follows :

$$F(a, b) = (a - b)^2 \text{ and } G(a, b) = |a - b|,$$

where $|x|$ represents the absolute value of x . What would be the value of $G(F(1, 3), G(1, 3))$? [EE]

- (A) 2 (B) 4
(C) 6 (D) 36
- 3.51 The three roots of the equation $f(x) = 0$ are $x = \{-2, 0, 3\}$. What are the three values of x for which $f(x-3) = 0$?

[EE]

- (A) -5, -3, 0 (B) -2, 0, 3
(C) 0, 6, 8 (D) 1, 3, 6
- 3.52 The area of an equilateral triangle is $\sqrt{3}$. What is the perimeter of the triangle? [AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]

- (A) 2 (B) 4
(C) 6 (D) 8
- 3.53 Arrange the following three-dimensional objects in the descending order of their volumes :
- (i) a cuboid with dimensions 10 cm, 8 cm and 6 cm.
(ii) a cube of side 8 cm.
(iii) a cylinder with base radius 7 cm and height 7 cm.
(iv) a sphere of radius 7 cm.

[AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]

- (A) (i), (ii), (iii), (iv)
(B) (ii), (i), (iv), (iii)
(C) (iii), (ii), (i), (iv)
(D) (iv), (iii), (ii), (i)

- 3.54 For $0 \leq x \leq 2\pi$, $\sin x$ and $\cos x$ are both decreasing functions in the interval _____. [AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]

- (A) $\left(0, \frac{\pi}{2}\right)$ (B) $\left(\frac{\pi}{2}, \pi\right)$
(C) $\left(\pi, \frac{3\pi}{2}\right)$ (D) $\left(\frac{3\pi}{2}, 2\pi\right)$

- 3.55 If $x^2 + x - 1 = 0$ what is the value of $x^4 + \frac{1}{x^4}$? [AG, AR, BT, CH, CY, GG,

IN, MT, PH, TF]

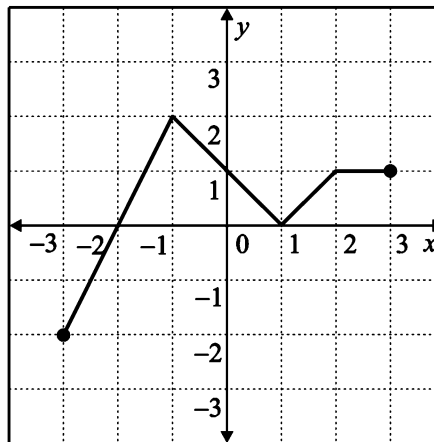
- (A) 1 (B) 5
(C) 7 (D) 9
- 3.56 A set of 4 parallel lines intersect with another set of 5 parallel lines. How many parallelograms are formed?

[AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]

- (A) 20 (B) 48
(C) 60 (D) 72
- 3.57 Hema's age is 5 years more than twice of Hari's age. Suresh's age is 13 years less than 10 times Hari's age. If Suresh is 3 times as old as Hema, how old is Hema?

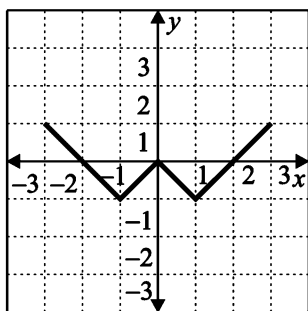
[CE-1]

- (A) 14 (B) 17
(C) 18 (D) 19
- 3.58 Which of the following function(s) is an accurate description of the graph for the range(s) indicated? [CE-1]



- (i) $y = 2x + 4$ for $-3 \leq x \leq -1$
(ii) $y = |x - 1|$ for $-1 \leq x \leq 2$

- (iii) $y = ||x| - 1|$ for $-1 \leq x \leq 2$
 (iv) $y = 1$ for $2 \leq x \leq 3$
 (A) (i), (ii) and (iii) only
 (B) (i), (ii) and (iv) only
 (C) (i) and (iv) only
 (D) (ii) and (iv) only
- 3.59 Given that $\frac{\log P}{y-z} = \frac{\log Q}{z-x} = \frac{\log R}{x-y} = 10$
 for $x \neq y \neq z$, what is the value of the product PQR ? [CE-2]
 (A) 0 (B) 1
 (C) xyz (D) 10^{xyz}
- 3.60 In manufacturing industries, loss is usually taken to be proportional to the square of the deviation from a target. If the loss is Rs. 4900 for a deviation of 7 units, what would be the loss in Rupees for a deviation of 4 units from the target? [CE-2]
 (A) 400 (B) 1200
 (C) 1600 (D) 2800
- 3.61 Which of the following functions describe the graph shown in figure below [EY, ME-1, PE, XE, XL]



- (A) $y = ||x| + 1| - 2$
 (B) $y = ||x| - 1| - 1$
 (C) $y = ||x| + 1| - 1$
 (D) $y = ||x - 1| - 1|$
- 3.62 A rectangle becomes a square when its length and breadth are reduced by 10m and 5 m respectively. During this

process, the rectangle loses 650 m² of area. What is the area of the original rectangle in square meters?

[EY, ME-1, PE, XE, XL]

- (A) 1125 (B) 2250
 (C) 2924 (D) 4500
- 3.63 For integers a, b and c what would be the minimum and maximum value respectively of $a+b+c$ if $\log|a| + \log|b| + \log|c| = 0$?

[EY, ME-1, PE, XE, XL]

- (A) -3 and 3 (B) -1 and 1
 (C) -1 and 3 (D) 1 and 3
- 3.64 The perimeters of a circle, a square and an equilateral triangle are equal. Which one of the following statement is true?

[AE, MA, ME-2, PI]

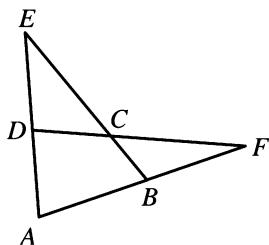
- (A) The circle has the largest area.
 (B) The square has the largest area.
 (C) The equilateral triangle has the largest area
 (D) All the three shapes have the same area
- 3.65 The value of the expression $\frac{1}{1 + \log_u vw} + \frac{1}{1 + \log_v wu} + \frac{1}{1 + \log_w uv}$ is _____ [AE, MA, ME-2, PI]
 (A) -1 (B) 0
 (C) 1 (D) 3

- 3.66 A wire would enclose an area of 1936 m², if it is bent into a square. The wire is cut into two pieces. The longer piece is thrice as long as the shorter piece. The long and the short pieces are bent into a square and a circle, respectively. Which of the following choices is closest to the sum of the areas enclosed by the two pieces in square meters? [AE, MA, ME-2, PI]
 (A) 1096 (B) 1111
 (C) 1243 (D) 2486

- 3.67 The area of a square is d . What is the area of the circle which has the diagonal of the square as its diameter? [CS, MN]

(A) πd (B) πd^2
 (C) $\frac{1}{4}\pi d^2$ (D) $\frac{1}{2}\pi d$

- 3.68 In the figure below, $\angle DEC + \angle BFC$ is equal to _____. [CS, MN]



(A) $\angle BCD - \angle BAD$
 (B) $\angle BAD + \angle BCF$
 (C) $\angle BAD + \angle BCD$
 (D) $\angle CBA + \angle ADC$

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- 3.69 A square has sides 5 cm smaller than the sides of a second square. The area of the larger square is four times the area of the smaller square. The side of the larger square is _____ cm. [CE-1]

(A) 15.10 (B) 8.50
 (C) 18.50 (D) 10.00

- 3.70 A retaining wall with measurements $30\text{m} \times 12\text{m} \times 6\text{m}$ was constructed with bricks of dimensions $8\text{cm} \times 6\text{cm} \times 6\text{cm}$. If 60% of the wall consists of bricks, the number of bricks used for the construction is _____ lakhs. [CE-2]

(A) 30 (B) 40
 (C) 75 (D) 45

- 3.71 Ten friends planned to share equally the cost of buying a gift for their teacher. When two of them decided not to

contribute, each of the other friends had to pay Rs. 150 more. The cost of the gift was Rs. _____. [CH, CS]

(A) 666 (B) 3000
 (C) 6000 (D) 12000

- 3.72 The product of three integers X , Y and Z is 192. If Z is equal to 4 and P is equal to average of X and Y . What is the minimum possible value of P ? [ME-2, TF, XE, XL]

(A) 7 (B) 9.5
 (C) 6 (D) 8

- 3.73 Suresh wanted to lay a new carpet in his new mansion with an area of 70×55 sq.mts. However an area of 550 sq.mts., had to be left out for flower pots. If the cost of carpet is Rs.50 per sq.mts., how much money (in Rs.) will be spent by Suresh for the carpet now? [CE-2]

(A) Rs.1,65,000 (B) Rs.2,75,000
 (C) Rs.1,92,500 (D) Rs.1,27,500

- 3.74 The sum and product of two integers are 26 and 165 respectively. The difference between these two integers is [CY, ME-1, MN]

(A) 4 (B) 6
 (C) 3 (D) 2

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- 3.75 a, b, c are real numbers. The quadratic equation $ax^2 - bx + c = 0$ has equal roots, which is β , then [AE, AG, EC, GG]

(A) $\beta^3 = \frac{bc}{(2a^2)}$ (B) $\beta^2 = ac$
 (C) $\beta = \frac{b}{a}$ (D) $b^2 \neq 4ac$

- 3.76 A superadditive function $f(\cdot)$ satisfies the following property

$$f(x_1 + x_2) \geq f(x_1) + f(x_2)$$

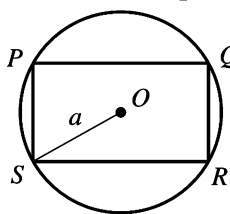
Which of the following functions is a superadditive function for $x > 1$?

[AE, AG, EC, GG]

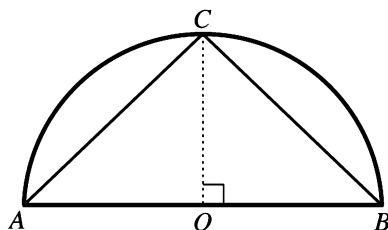
- (A) $\sqrt{x}$ (B) e^x
 (C) $\frac{1}{x}$ (D) e^{-x}

- 3.77 A circle with center O is shown in the figure. A rectangle $PQRS$ of maximum possible area is inscribed in the circle. If the radius of the circle is a , then the area of shaded portion is _____.

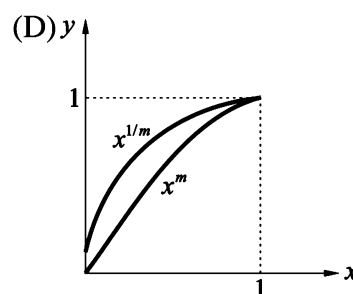
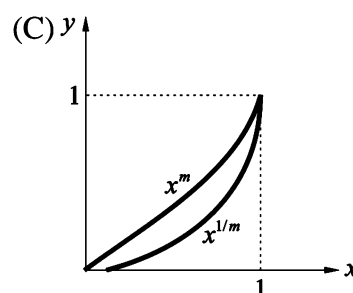
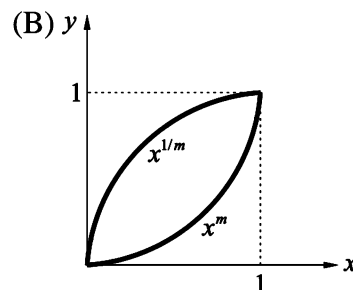
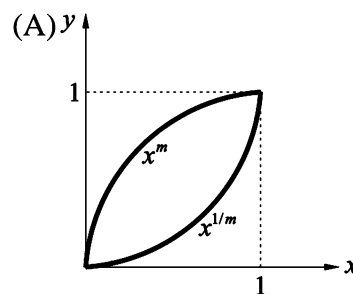
[AE, AG, EC, GG]



- (A) $\pi a^2 - a^2$ (B) $\pi a^2 - 3a^2$
 (C) $\pi a^2 - \sqrt{2}a^2$ (D) $\pi a^2 - 2a^2$
- 3.78 Given a semicircle with O as the centre, as shown in the figure, the ratio $\frac{\overline{AC} + \overline{CB}}{\overline{AB}}$ is _____. where $\overline{AC}$, $\overline{CB}$ and $\overline{AB}$ are chords. [EE, EY, TF]



- (A) $\sqrt{3}$ (B) 3
 (C) 2 (D) $\sqrt{2}$
- 3.79 Define $[x]$ as the greatest integer less than or equal to x , for each $x \in (-\infty, \infty)$. If $y = [x]$, then area under y for $x \in [1, 4]$ is _____. [IN, ME-1, MT, PE, PH]
- (A) 4 (B) 3
 (C) 6 (D) 1
- 3.80 Select the graph that schematically represents both $y = x^m$ and $y = x^{1/m}$ properly in the interval $0 \leq x \leq 1$, for integer values of m , where $m > 1$. [IN, ME-1, MT, PE, PH]



- 3.81 The sum of two positive numbers is 100. After subtracting 5 from each number, the product of the resulting numbers is 0. One of the original numbers is _____. [CE-1]

- (A) 90 (B) 80
 (C) 95 (D) 85

- 3.82 The unit's place in 26591749^{10016} is _____. [CE-1]

- (A) 9 (B) 3
 (C) 1 (D) 6

3.83 If $f(x) = x^2$ for each $x \in (-\infty, \infty)$, then $\frac{f(f(f(x)))}{f(x)}$ is equal to _____. [CE-2]

- (A) $(f(x))^3$ (B) $(f(x))^2$
(C) $(f(x))^4$ (D) $f(x)$

3.84 For the year 2019, which of the previous year's calendar can be used? [CE-2]

- (A) 2014 (B) 2012
(C) 2011 (D) 2013

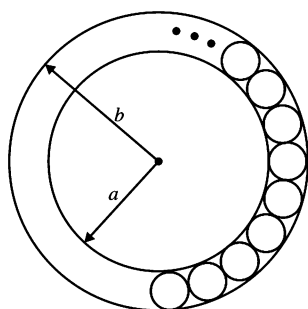
3.85 In a school of 1000 students, 300 students play chess and 600 students play football. If 50 students play both chess and football, the number of students who play neither is _____. [CE-2]

- (A) 200 (B) 150
(C) 50 (D) 100

3.86 The ratio of 'the sum of the odd positive integers from 1 to 100' to 'the sum of the even positive integers from 150 to 200' is _____. [CE-2]

- (A) 1 : 1 (B) 45 : 95
(C) 50 : 91 (D) 1 : 2

3.87 The figure below shows an annular right with outer and inner radii as b and a , respectively. The annular space has been painted in the form of blue colour circles touching the outer and inner periphery of annular space. If maximum n number of circles can be painted, then the unpainted area available in annular space is _____. [CS]



(A) $\pi[(b^2 - a^2) - n(b - a)^2]$

(B) $\pi[(b^2 - a^2) + n(b - a)^2]$

(C) $\pi[(b^2 - a^2) - \frac{n}{4}(b - a)^2]$

(D) $\pi[(b^2 - a^2) + \frac{n}{4}(b - a)^2]$

3.88 Two straight lines are drawn perpendicular to each other in X-Y plane. If α and β are the acute angles the straight lines make with the X-axis, then $\alpha + \beta$ is _____. [CS]

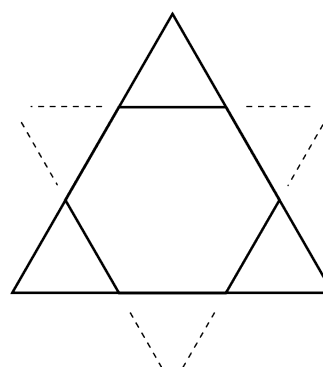
- (A) 120° (B) 60°
(C) 90° (D) 180°

3.89 For a matrix $M = [m_{ij}]$; $i, j = 1, 2, 3, 4$ the diagonal elements are all zero and $m_{ij} = -m_{ji}$. The minimum number of elements required to fully specify the matrix is _____. [AR, BM, BT, CH, MA, MN, ST, XE, XL]

- (A) 12 (B) 16
(C) 6 (D) 0

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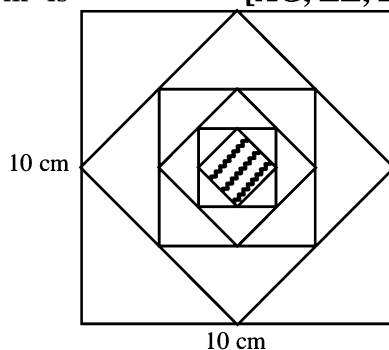
3.90



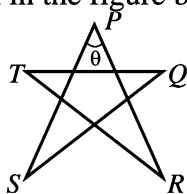
Corners are cut from an equilateral triangle to produce a regular convex hexagon as shown in the figure above. The ratio of the area of the regular convex hexagon to the area of original equilateral triangle is

[EC, ES, PE, PI, ST]

- (A) 5 : 6 (B) 3 : 4
(C) 4 : 5 (D) 2 : 3
- 3.91** Consider a square sheet of side 1 unit. In the first step, it is cut along the main diagonal to get two triangles. In the next step, one of the cut triangle is revolved about its short edge to form a solid cone. The volume of a resulting cone, in cubic units, is _____. [EC, ES, PE, PI, ST]
- (A) $\frac{2\pi}{3}$ (B) 3π
(C) $\frac{\pi}{3}$ (D) $\frac{3\pi}{2}$
- 3.92** For a regular polygon having 10 sides, the interior angle between the sides of the polygon, in degree is _____ [AG, EE, EY, GG]
- (A) 324 (B) 216
(C) 144 (D) 396
- 3.93** In the figure shown above, each inside square is formed by joining the mid points of the sides of the next larger square. The area of the smallest square (shaded) as shown, in cm^2 is [AG, EE, EY, GG]



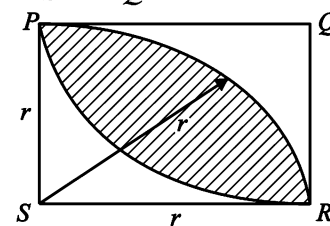
- (A) 6.25 (B) 3.125
(C) 12.50 (D) 1.5625
- 3.94** Five line segments of equal lengths, PR , PS , QS , QT and RT are used to form a star as shown in the figure below.



The value of θ , in degrees, is _____
[CE-1, CY, IN]

- (A) 36 (B) 108
(C) 72 (D) 45
- 3.95** Consider two rectangular sheet M and sheet N of identical dimensions of $6 \text{ cm} \times 4 \text{ cm}$ each.
- Folding operation (i) : The sheet is folded into half by joining the short edges of the current shape.
- Folding operation (ii) : The sheet is folded into half by joining the long edges of the current shape.
- Folding operation (i) is carried out on sheet M three times.
- Folding operation (ii) is carried out on sheet N three times.
- The ratio of perimeters of the final folded shape of sheet N to the final folded shape of sheet M is _____. [CE-1, CY, IN]
- (A) 3 : 2 (B) 7 : 5
(C) 13 : 7 (D) 5 : 13
- 3.96** In an equilateral triangle PQR , side PQ is divided into four equal parts, side QR is divided into six equal parts and side PR is divided into eight equal parts. The length of each sub-divided part in cm is an integer. The minimum area of the triangle PQR possible, in cm^2 , is [AE, AR, BM, CE-2, MN, PH]

- (A) 18 (B) $144\sqrt{3}$
(C) $48\sqrt{3}$ (D) 24
- 3.97** In the figure, $PQRS$ is a square. The shaded portion is formed by the intersection of sectors of circle with radius equal to the side of the square and centers at S and Q .

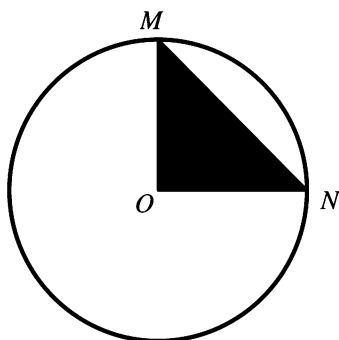


The probability that any point picked randomly within the square falls in the shaded area is _____.

[AE, AR, BM, CE-2, MN, PH]

- (A) $\frac{1}{2}$ (B) $4 - \frac{\pi}{2}$
(C) $\frac{\pi}{2} - 1$ (D) $\frac{\pi}{4}$

3.98



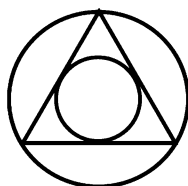
In the above figure, O is the center of the circle and, M and N lie on the circle. The area of the right triangle MON is 50 cm^2 .

What is the area of the circle in cm^2 ?

[ME-1, XH]

- (A) 2π (B) 50π
(C) 100π (D) 75π

3.99



The ratio of the area of the inscribed circle to the area of the circumscribed circle of an equilateral triangle is _____.

[ME-2, MT]

- (A) $1/6$ (B) $1/8$
(C) $1/2$ (D) $1/4$

3.100 Consider a square sheet of side 1 unit. The sheet is first folded along the main diagonal. This is followed by a fold along its line of symmetry. The resulting folded shape is again folded along its line of

symmetry. The area of each face of the final folded shape, in square units, equal to _____

[ME-2, MT]

- (A) $1/8$ (B) $1/16$
(C) $1/4$ (D) $1/32$

3.101 We have 2 rectangular sheets of paper, M and N , of dimensions $6 \text{ cm} \times 1 \text{ cm}$ each. Sheet M is rolled to form an open cylinder by bringing the short edges of the sheet together. Sheet N is cut into equal square patches and assembled to form the largest possible closed cube. Assuming the ends of the cylinder are closed, the ratio of the volume of the cylinder to that of the cube is _____.

[BT, CH, CS-1, MA, TF]

- (A) $\frac{9}{\pi}$ (B) 3π
(C) $\frac{\pi}{2}$ (D) $\frac{3}{\pi}$

3.102 A polygon is convex if, for every pair of points P and Q belonging to the polygon, the line segment PQ lies completely inside or on the polygon.

Which one of the following is NOT a convex polygon?

[BT, CH, CS-1, MA, TF]

- (A)  (B) 
(C)  (D) 

3.103 If θ is the angle, in degrees, between the longest diagonal of the cube and any one of the edges of the cube, then, $\cos \theta =$

[CS-2, XE, XL]

- (A) $\frac{1}{\sqrt{3}}$ (B) $\frac{1}{\sqrt{2}}$
(C) $\frac{1}{2}$ (D) $\frac{\sqrt{3}}{2}$

2022

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- 3.104** The letters P, Q, R, S, T and U are to be placed one per vertex on a regular convex hexagon, but not necessarily in the same order.

Consider the following statements :

- The line segment joining R and S is longer than the line segment joining P and Q.
- The line segment joining R and S is perpendicular to the line segment joining P and Q.
- The line segment joining R and U is parallel to the line segment joining T and Q.

Based on the above statements, which one of the following options is CORRECT?

[EE]

- (A) The line segment joining T and Q is parallel to the line joining P and U.
 (B) The line segment joining Q and S is perpendicular to the line segment joining R and P.
 (C) The line segment joining R and T is parallel to the line segment joining Q and S.
 (D) The line segment joining R and P is perpendicular to the line segment joining U and Q.

- 3.105** Consider the following inequalities.

- (i) $2x - 1 > 7$
 (ii) $2x - 9 < 1$

Which one of the following expressions below satisfies the above two inequalities?

[ECE]

- (A) $x \leq -4$ (B) $-4 < x \leq 4$
 (C) $x \geq 5$ (D) $4 < x < 5$

- 3.106** Four points $P(0, 1)$, $Q(0, -3)$, $R(-2, -1)$ and $S(2, -1)$ represent the vertices of a quadrilateral.

What is the area enclosed by the quadrilateral?

[ECE]

- (A) $8\sqrt{2}$ (B) 4
 (C) 8 (D) $4\sqrt{2}$

- 3.107** Inhaling the smoke from a burning _____ could _____ you quickly.

[IN, CH, PI]

- (A) tire/tyre (B) tyre/tier
 (C) tyre/tire (D) tire/tier

- 3.108** A sphere of radius r cm is packed in a box of cubical shape.

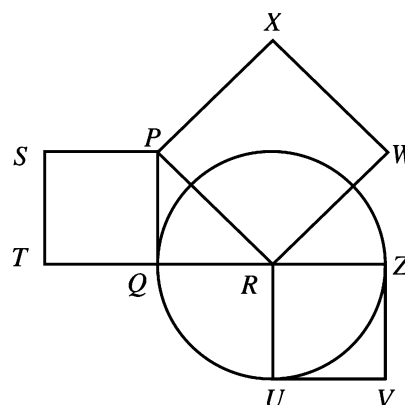
What should be the minimum volume (in cm^3) of the box that can enclose the sphere?

[IN, CH, PI]

- (A) $2r^3$ (B) $\frac{r^3}{8}$
 (C) $8r^3$ (D) r^3

- 3.109** In the following diagram the point R is the center of circle. The line PQ and ZV are tangential to the circle. The relation among the areas of the squares, PXWR, RUVZ and SPQT is

[CE-1]



- (A) Area of SPQT = Area of RUVZ = Area of PXWR

(B) Area of SPQT = Area of PXWR – Area of RUVZ

(C) Area of PXWR = Area of SPQT – Area of RUVZ

(D) Area of PXWR = Area of RUVZ – Area of SPQT

3.110 A survey of 450 students about their subject of interest resulted in the following outcome.

- 150 students are interested in mathematics
- 200 students are interested in physics
- 175 students are interested in chemistry
- 50 students are interested in mathematics and physics
- 60 students are interested in physics and chemistry
- 40 students are interested in mathematics and chemistry
- 30 students are interested in mathematics physics and chemistry
- Remaining students are interested in humanities

Based on the above information the number of students interested in humanities is.

[CE-2]

- (A) 10 (B) 45
(C) 30 (D) 40

3.111 Consider the following equations of straight lines :

Line L1 : $2x - 3y = 5$

Line L2 : $3x + 2y = 8$

Line L3 : $4x - 6y = 5$

Line L4 : $6x - 9y = 6$

Which one among the following is the correct statement?

[CE-2]

(A) L2 is parallel to L4 and L2 is perpendicular to L1

(B) L1 is parallel to L2 and L1 is perpendicular to L3

(C) L3 is perpendicular to L4 and L3 is parallel to L2

(D) L4 is perpendicular to L2 and L4 is parallel to L3

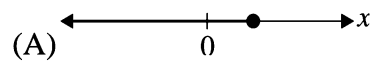
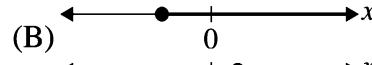
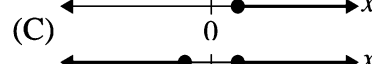
3.112 In a 12-hour clock that runs correctly, how many times do the second, minute, and hour hands of the clock coincide, in a 12-hour duration from 3 PM in a day to 3 AM the next day?

[ME-1]

- (A) 11 (B) 12
(C) 144 (D) 2

3.113 Which one of the following is a representation (not to scale and in bold) of all values of x satisfying the inequality $2 - 5x \leq -\frac{6x-5}{3}$ on the real number line?

[ME-2]

- (A) 
(B) 
(C) 
(D) 

3.114 A person was born on the fifth Monday of February in a particular year. Which one of the following statements is correct based on the above information? [ME-2]

- (A) The 2nd February of that year is a Tuesday
(B) There will be five Sundays in the month of February in that year
(C) The 1st February of that year is a Sunday
(D) All Mondays of February in that year have even dates

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3.115 Consider two functions of time (t),

$$f(t) = 0.01t^2$$

$$g(t) = 4t$$

Where $0 < t < \infty$.

Now consider the following two statements :

- (i) For some $t > 0$, $g(t) > f(t)$
 (ii) There exists a T , such that $f(t) > g(t)$ for all $t > T$

Which one of the following options are TRUE?

[CSE]

- (A) only (ii) is correct
 (B) both (i) and (ii) are correct
 (C) neither (i) nor (ii) is correct
 (D) only (i) is correct

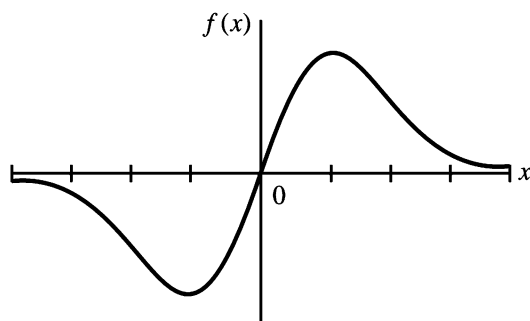
3.116 The minute-hand and second hand of clock cross each other _____ times between 9:15 AM to 9:45 AM on a day.

[ME]

- (A) 30 (B) 15
 (C) 29 (D) 31

3.117 Which one of the following options represents the given graph?

[EE]



- (A) $f(x) = x^2 2^{-|x|}$ (B) $f(x) = x 2^{-|x|}$
 (C) $f(x) = |x| 2^{-x}$ (D) $f(x) = x 2^{-x}$

3.118 What is the smallest number with distinct digits whose digits adds up to 45?

[ECE]

- (A) 123555789 (B) 123457869
 (C) 123456789 (D) 99999

3.119 Forestland is a planet inhabited by different kinds of creatures. Among other creatures, it is populated by animals all of whom are ferocious. There are also creatures that have claws, and some that do not. All creatures that have claws are ferocious.

Based only on the information provided above, which one of the following options can be logically inferred with certainty?

[ECE]

- (A) All creatures with claws are animals.
 (B) Some creatures with claws are non-ferocious.
 (C) Some non-ferocious creatures have claws.
 (D) Some ferocious creatures are creatures with claws.

3.120 The village was nested in a green spot, _____ the ocean and the hills.

[IN, XE]

- (A) through (B) in
 (C) at (D) between

3.121 A 'frabjous' number is defined as a 3 digit number with all digits odd, and no two adjacent digits being the same. For example, 137 is a frabjous number, while 133 is not. How many such frabjous numbers exist?

[IN, XE]

- (A) 125 (B) 720
 (C) 60 (D) 80

3.122 Ankita has to climb 5 stairs starting at the ground, while respecting the following rules :

1. At any stage, Ankita can move either one or two stairs up.
2. At any stage, Ankita cannot move to a lower step.

Let $F(N)$ denote the number of possible ways in which Ankita can reach the N^{th} stair.

For example,

$$F(1) = 1, F(2) = 2, F(3) = 3.$$

The value of $F(5)$ is _____.

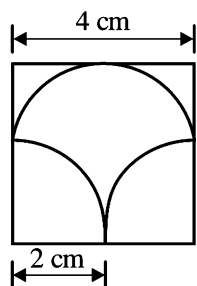
[IN, XE]

- (A) 8 (B) 7
(C) 6 (D) 5

3.123 A square of side length 4 cm is given. The boundary of the shaded region is defined by one semi-circle on the top and two circular arcs at the bottom, each of radius 2 cm, as shown.

The area of the shaded region is _____ cm^2 .

[CE-1]



- (A) 8 (B) 4
(C) 12 (D) 10

3.124 If x satisfies the equation $4^{8^x} = 256$, then x is equal to _____.

[CE-2]

- (A) $\frac{1}{2}$ (B) $\log_{16} 8$
(C) $\frac{2}{3}$ (D) $\log_4 8$

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3.125 For a real number $x > 1$.

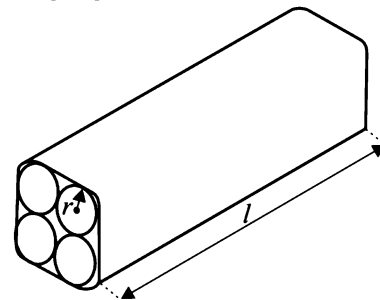
$$\frac{1}{\log_2 x} + \frac{1}{\log_3 x} + \frac{1}{\log_4 x} = 1$$

The value of x is

- (A) 4 (B) 12
(C) 24 (D) 36

[ECE]

3.126 Four identical cylindrical chalk-sticks, each of radius $r = 0.5 \text{ cm}$ and length $l = 10 \text{ cm}$, are bound tightly together using a duct tape as shown in the following figure.



The width of the duct tape is equal to the length of the chalk-stick. The area (in cm^2) of the duct tape required to wrap the bundle of chalk - sticks once, is

(A) $20(4 + \pi)$ (B) $20(8 + \pi)$
(C) $10(8 + \pi)$ (D) $10(4 + \pi)$

[ECE]

3.127 Two identical sheets A and B, of dimensions $24 \text{ cm} \times 16 \text{ cm}$, can be folded into half using two distinct operations, FO1 or FO2.

In FO1, the axis of folding remains parallel to the initial long edge, and in FO2, the axis of folding remains parallel to the initial short edge.

If sheet A is folded twice using FO1, and sheet B is folded twice using FO2, the ratio of the perimeters of the final shapes of A and B is

- (A) 14:11 (B) 11:14
(C) 18:11 (D) 11:18

[ECE]

- 3.128 The decimal number system uses the characters 0, 1, 2, ..., 8, 9, and the octal number system uses the characters 0, 1, 2, ..., 6, 7.

For example, the decimal number 12 ($=1 \times 10^1 + 2 \times 10^0$) is expressed as 14 ($=1 \times 8^1 + 4 \times 8^0$) in the octal number system.

The decimal number 108 in the octal number system is

- (A) 168 (B) 108
(C) 150 (D) 154

[EE]

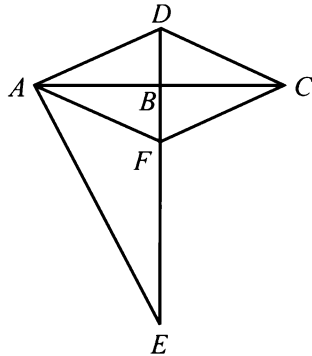
- 3.129 In the following figure.

$CD = 5$ cm, $BE = 10$ cm, $AE = 12$ cm.

$\angle DAB = \angle DCB$ and

$\angle DAE = \angle DBC = 90^\circ$

Points A, F, C, D create a rhombus.



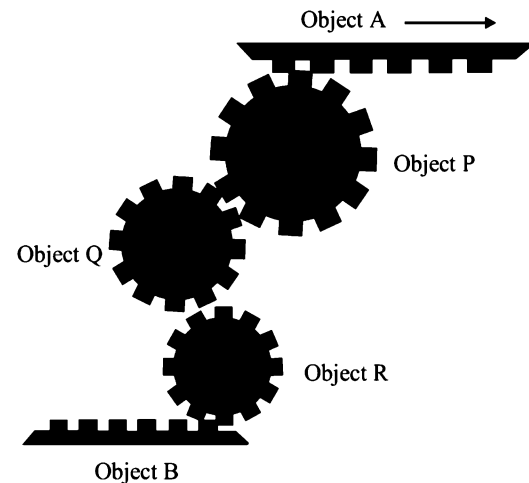
The length of BF (in cm) is

- (A) 3 (B) 2
(C) 4 (D) 6

[EE]

- 3.130 The assembly shown below has three teathed circular objects (Pinions) and two teathed flat objects (Racks), which are perfectly mating with each other. Pinions can only rotate clockwise or anti-

clockwise staying at its own center. Racks can translate towards the left ($\leftarrow$) or the right ($\rightarrow$) direction.



If the object A (Rack) is translating towards the right ($\rightarrow$) direction, the correct statement among the following is

- (A) Object B translates towards the right direction.
(B) Object B translates towards the left direction.
(C) Object R rotates in the anticlockwise direction.
(D) Object Q rotates in the clockwise direction.

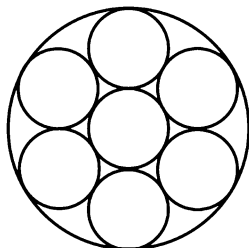
[EE]

- 3.131 A surveyor has to measure the horizontal distance from her position to a distant reference point C . Using her position as the center, a 200 m horizontal line segment is drawn with the two endpoints A and B . Points A , B and C are not collinear. Each of the angles $\angle CAB$ and $\angle CBA$ are measured as 87.8° . The distance (in m) of the reference point C from her position is nearest to

- (A) 2603 (B) 2606
(C) 2306 (D) 2063

[EE]

- 3.132** Seven identical cylindrical chalk-sticks are fitted tightly in a cylindrical container. The figure below shows the arrangement of the chalk-sticks inside the cylinder.



The length of the container is equal to the length of the chalk-sticks. The ratio of the occupied space to the empty space of the container is

- (A) $5/2$ (B) $7/2$
(C) $9/2$ (D) 3

[IN, CE-2]

- 3.133** Visualize a cube that is held with one of the four body diagonals aligned to the vertical axis. Rotate the cube about this axis such that its view remains unchanged. The magnitude of the minimum angle of rotation is

- (A) 120° (B) 60°
(C) 90° (D) 180°

[IN, CE-2]

- 3.134** For positive integers p and q , with

$$\frac{p}{q} \neq 1, \left(\frac{p}{q}\right)^{\frac{p}{q}} = p^{\left(\frac{p-1}{q}\right)}. \text{ Then}$$

- (A) $q^p = p^q$ (B) $q^p = p^{2q}$
(C) $\sqrt{q} = \sqrt{p}$ (D) $\sqrt[p]{q} = \sqrt[q]{p}$

[CE-1, CH]

- 3.135** In the 4×4 array shown below, each cell of the first three columns has either a cross ($\times$) or a number, as per the given rule.

1	1	2	
2	$\times$	3	
2	$\times$	4	
1	2	$\times$	

Rule : The number in a cell represents the count of crosses around its immediate neighboring cells (left, right, top, bottom, diagonals).

As per this rule, the **maximum** number of crosses possible in the empty column is

- (A) 0 (B) 1
(C) 2 (D) 3

[CE-1, CH]

- 3.136** The real variables x, y, z , and the real constants p, q, r satisfy

$$\frac{x}{pq-r^2} = \frac{y}{qr-p^2} = \frac{z}{rp-q^2}$$

Given that the denominators are non-zero, the value of $px + qy + rz$ is

- (A) 0 (B) 1
(C) pqr (D) $p^2 + q^2 + r^2$

[ME]

- 3.137** Four equilateral triangles are used to form a regular closed three-dimensional object by joining along the edges. The angle between any two faces is :

- (A) 30° (B) 60°
(C) 45° (D) 90°

[ME]

- 3.138** If two distinct non - zero variables x and y are such that $(x + y)$ is proportional to

$(x - y)$ then the value of $\frac{x}{y}$

- (A) Depends on xy
 (B) Depends only on x not on y
 (C) Depends only on y and not on x
 (D) is a constant

[CS-1]

- 3.139** A rectangular paper sheet of dimensions $54\text{cm} \times 4\text{cm}$ is taken. The two longer edges of the sheet are joined together to create a cylindrical tube. A cube whose surface area is equal to the area of the sheet is also taken.

Then, the ratio of the volume of the cylindrical tube to the volume of the cube is

- (A) $\frac{1}{\pi}$ (B) $\frac{2}{\pi}$
 (C) $\frac{3}{\pi}$ (D) $\frac{4}{\pi}$

[CS-1]

- 3.140** A rectangular paper of $20\text{cm} \times 8\text{cm}$ is folded 3 times. Each fold is made along the line of symmetry, which is perpendicular to its long edge. The perimeter of the final folded sheet (in cm) is

- (A) 18 (B) 24
 (C) 20 (D) 21

[CS-1]

- 3.141** For positive non-zero real variables x and y , if $\ln\left(\frac{x+y}{2}\right) = \frac{1}{2}[\ln(x) + \ln(y)]$ then, the value of $\frac{x}{y} + \frac{y}{x}$ is

- (A) 1 (B) $\frac{1}{2}$
 (C) 2 (D) 4

[CS-2]

- 3.142** A cube is to be cut into 8 pieces of equal size and shape. Here, each cut should be

straight and it should not stop till it reaches the other end of the cube. The minimum number of such cuts required is

- (A) 3 (B) 4
 (C) 7 (D) 8

[CS-2]

- 3.143** In the 4×4 array shown below, each cell of the three rows has either a cross (x) or a number.

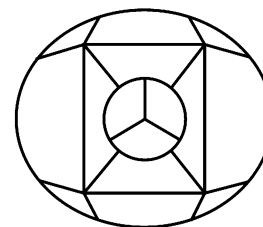
1	×	4	3
×	5	5	4
3	×	6	×

The number in a cell represents the count of the immediate neighboring cells (left, right, top, bottom, diagonals) NOT having a cross (X). Given that the last row has no crosses (X), the sum of the four numbers to be filled in the last row is

- (A) 11 (B) 10
 (C) 12 (D) 9

[CS-2]

- 3.144** The 15 parts of the given figure are to be painted such that no two adjacent parts with shared boundaries (excluding corners) have the same color. The minimum number of colors required is



- (A) 4 (B) 3
 (C) 5 (D) 6

[PI, DA]

- 3.145** Visualize two identical right circular cones such that one is inverted over the other and they share a common circular base. If a cutting plane passes through

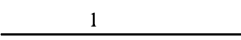
the vertices of the assembled cones, what shape does the outer boundary of the resulting cross-section make? [PI, DA]

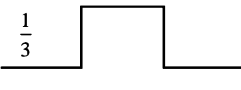
- (A) A rhombus (B) A triangle
(C) An ellipse (D) A hexagon

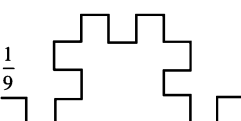
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3.146 The following figures show three curves generated using an iterative algorithm. The total length of the curve generated after 'Iteration n ' is : [ECE]

Note : The figures shown are representative.

Iteration 0 : 

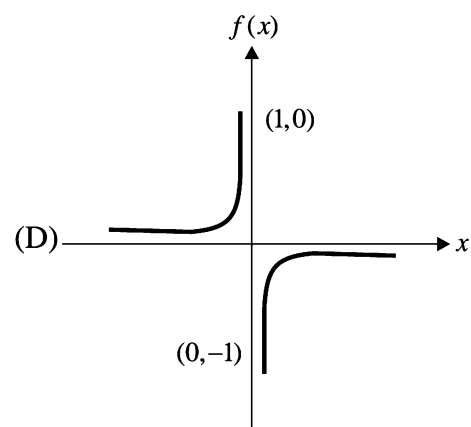
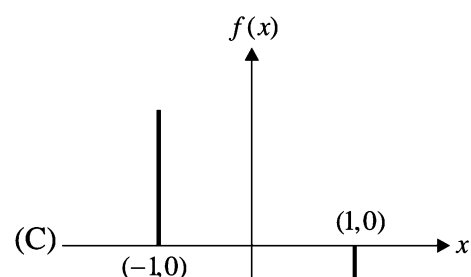
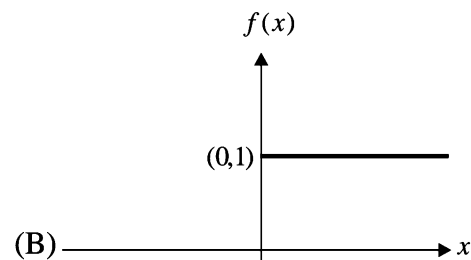
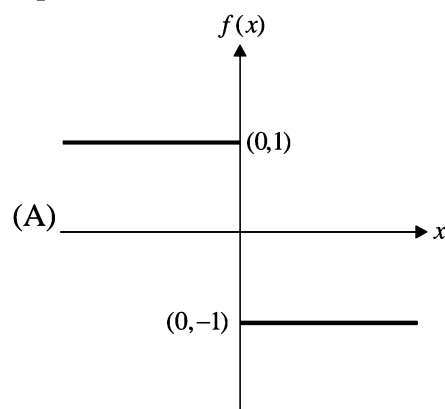
Iteration 1 :  Length of each segment : $\frac{1}{3}$

Iteration 2 :  Length of each segment : $\frac{1}{9}$

- (A) $\left(\frac{5}{3}\right)^{\frac{n}{2}}$ (B) $\left(\frac{5}{3}\right)^n$
(C) $\left(\frac{5}{3}\right)^{2n}$ (D) $\left(\frac{5}{3}\right)^{n(2n-1)}$

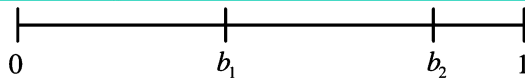
3.147 Which one of the following plots represents $f(x) = -\frac{|x|}{x}$, where x is a non-zero real number? [ECE]

Note : The figures shown are representative.



3.148 A stick of length one meter is broken at two locations at distances of b_1 and b_2 from the origin (0), as shown in the figure. Note that $0 < b_1 < b_2 < 1$. Which one of the following is NOT a necessary condition for forming a triangle using the three pieces? [ECE]

Note : All lengths are in meter. The figure shown is representative.



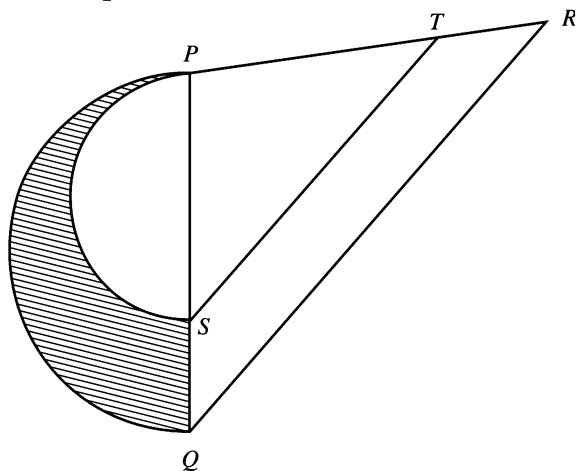
- (A) $b_1 < 0.5$ (B) $b_2 > 0.5$
 (C) $b_2 < b_1 + 0.5$ (D) $b_1 + b_2 < 1$

3.149 In the triangle PQR , the lengths of PT and TR are in the ratio of 3:2.

ST is parallel to QR . Two semicircles are drawn with PS and PQ as diameters, as shown in the figure.

Which one of the following statements is true about the shaded area PQS ?

Note : The figure shown is representative.



[EE]

- (A) The shaded $\frac{16}{9}$ times the area of the semicircle with the diameter PS .
 (B) The shaded area is equal to the area of the semicircle with the diameter PS .
 (C) The shaded area is $\frac{14}{9}$ times the area of the semicircle with the diameter PS .
 (D) The shaded area is $\frac{14}{25}$ times the area of the semicircle with the diameter PQ .

3.150 If $Pe^x = Qe^{-x}$ for all real values of x , which one of the following statements is true? [IN, CS-2]

- (A) $P = Q = 0$ (B) $P = Q = 1$
 (C) $P = 1; Q = -1$ (D) $\frac{P}{Q} = 0$

3.151 Which one of the following options is correct for the given data in the table

Iteration (i)	0	1	2	3
Input (I)	20	-4	10	15
Output (X)	20	16	26	41
Output (Y)	20	-80	-800	-12000

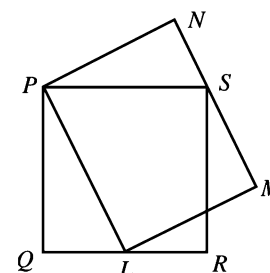
[IN, CS-2]

- (A) $X(i) = X(i-1) + I(i); Y(i) = Y(i-1); i > 0$
 (B) $X(i) = X(i-1)I(i); Y(i) = Y(i-1) + I(i); i > 0$
 (C) $X(i) = X(i-1)I(i); Y(i) = Y(i-1)I(i-1); i > 0$
 (D) $X(i) = X(i-1) + I(i); Y(i) = Y(i-1)I(i-1); i > 0$

3.152 In the given figure, PQRS is a square of side 2 cm and PLMN is a rectangle. The corner L of the rectangle is on the side QR. Side MN of the rectangle passes through the corner S of the square.

What is the area (in cm^2) of the rectangle PLMN? [IN, CS-2]

Note : The figure shown is representative.



- (A) $2\sqrt{2}$ (B) 2
(C) 8 (D) 4

- 3.153** A thin wire is used to construct all the edges of a cube of 1 m side by bending, cutting and soldering the wire. If the wire is 12 m long, what is the minimum number of cuts required to construct the wire frame to form the cube?

[CE-1, CH]

- (A) 3 (B) 4
(C) 6 (D) 12

- 3.154** Rohit goes to a restaurant for lunch at about 1 PM. When he enters the restaurant, he notices that the hour and minute hands on the wall clock are exactly coinciding. After about an hour, when he leaves the restaurant, he notices that the clock hands are again exactly coinciding. How much time (in minutes) did Rohit spend at the restaurant?

[CE-1, CH]

- (A) $64\frac{6}{11}$ (B) $66\frac{5}{13}$
(C) $65\frac{5}{11}$ (D) $66\frac{6}{13}$

- 3.155** A circle with center at $(x, y) = (0.5, 0)$ and radius = 0.5 intersects with another circle with center at $(x, y) = (1, 1)$ and radius = 1 at two points. One of the points of intersection (x, y) is : [CE-1, CH]

- (A) (0, 0) (B) (0.2, 0.4)
(C) (0.5, 0.5) (D) (1, 2)

- 3.156** In the context of the given figure, which one of the following options correctly represents the entries in the blocks labelled (i), (ii), (iii), and (iv), respectively? [CE-2, XE]

N	U	F	(i)
21	14	9	6
H	L	(ii)	O
12	(iv)	15	(iii)

- (A) Q, M, 12, and 8
(B) K, L, 10 and 14
(C) I, J, 10, and 8
(D) L, K, 12 and 8

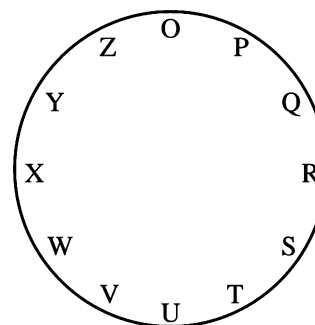
- 3.157** For the clock shown in the figure, if

$$O^* = O Q S Z P R T \text{ and}$$

$$X^* = X Z P W Y O Q,$$

then which one among the given options is most appropriate for P^* ?

[CE-2, XE]



- (A) P U W R T V X
(B) P R T O Q S U
(C) P T V Q S U W
(D) P S U P R T V

- 3.158** Consider a five-digit number $PQRST$ that has distinct digits P, Q, R, S , and T , and satisfies the following conditions :

$$P < Q$$

$$S > P > T$$

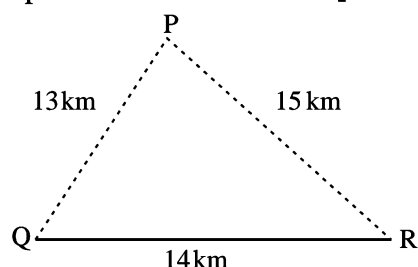
$$R < T$$

If integers 1 through 5 are used to construct such a number, the value of P is : [CE-2, XE]

- (A) 1 (B) 2
(C) 3 (D) 4

- 3.159** Three villages P, Q, and R are located in such a way that the distance $PQ = 13$ km, $QR = 14$ km, and $RP = 15$ km, as shown in the figure. A straight road joins Q and R. It is proposed to connect P to this road QR by constructing another road. What is the minimum possible length (in km) of this connecting road?

Note : The figure shown is representative. [CE-2, XE]



- (A) 10.5 (B) 11.0
(C) 12.0 (D) 12.5

- 3.160** The ceiling function of a real number x , denoted by $\lceil x \rceil$, is defined as the smallest integer that is greater than or equal to x . Similarly, the floor function, denoted by $\lfloor x \rfloor$, is defined as the largest integer that is smaller than or equal to x . Which one of the following statements is NOT correct for all possible values of x ?

[ME, PE]

- (A) $\lceil \lceil x \rceil \rceil \geq x$ (B) $\lfloor \lfloor x \rfloor \rfloor \geq x$
(C) $\lceil \lceil x \rceil \rceil \geq \lfloor \lfloor x \rfloor \rfloor$ (D) $\lfloor \lfloor x \rfloor \rfloor < \lceil \lceil x \rceil \rceil$

- 3.161** Which one of the following options has the correct sequence of objects arranged in the increasing number of mirror lines (lines of symmetry)? [ME, PE]

- (A) Circle; Square; Equilateral triangle; Isosceles triangle
(B) Isosceles triangle; Equilateral triangle; Square; Circle

(C) Equilateral triangle; Isosceles triangle; Square; Circle

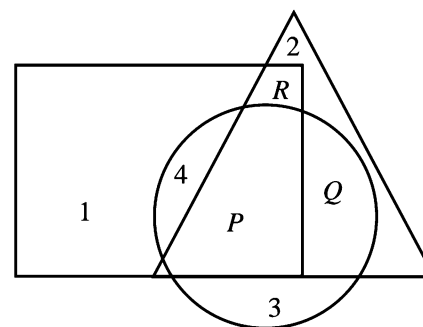
(D) Isosceles triangle; Square; Equilateral triangle; Circle

- 3.162** A 4×4 digital image has pixel intensities (U) as shown in the figure. The number of pixels with $U \leq 4$ is : [PI, DA]

0	1	0	2
4	7	3	3
5	5	4	4
6	7	3	2

- (A) 3 (B) 8
(C) 11 (D) 9

- 3.163** In the given figure, the numbers associated with the rectangle, triangle, and ellipse are 1, 2, and 3, respectively. Which one among the given options is the most appropriate combination of P, Q, and R ? [PI, DA]



- (A) $P = 6$; $Q = 5$; $R = 3$
(B) $P = 5$; $Q = 6$; $R = 3$
(C) $P = 3$; $Q = 6$; $R = 6$
(D) $P = 5$; $Q = 3$; $R = 6$

- 3.164** A rectangle has a length L and a width W , where $L > W$. If the width, W , is increased by 10%, which one of the following statements is correct for all values of L and W ? [PI, DA]

- (A) Perimeter increases by 10%.
(B) Length of the diagonals increases by 10%.

(C) Area increases by 10%.

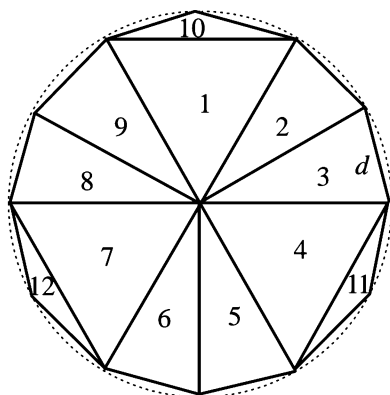
(D) The rectangle becomes a square.

- 3.165** A regular dodecagon (12-sided regular polygon) is inscribed in a circle of radius r cm as shown in the figure. The side of the dodecagon is d cm. All the triangles (numbered 1 to 12) in the figure are used to form squares of side r cm and each numbered triangle is used only once to form a square.

The number of squares that can be formed and the number of triangles required to form each square, respectively, are:

Note: The figure shown is representative.

[PI, DA]



- (A) 3; 4 (B) 4; 3
(B) 3; 3 (D) 3; 2

- 3.166** If a real variable x satisfies $3^{x^2} = 27 \times 9^x$

, then the value of $\frac{2^{x^2}}{(2^x)^2}$ is : [PI, DA]

- (A) 2^{-1} (B) 2^0
(C) 2^3 (D) 2^{15}

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- 3.167** The statements (S_1) , (S_2) , and (S_3) pertain to the scores obtained by students in an exam. The maximum possible marks in the exam is 150.

(S_1) The highest score is 100.

(S_2) The fourth highest score is 76.

(S_3) There are at least four students whose scores are within 25 of each other.

Which one of the following options is necessarily correct? [EC]

- (A) (S_1) and (S_2) together imply (S_3)
(B) (S_1) and (S_3) together imply (S_2)
(C) (S_2) and (S_3) together imply (S_1)
(D) (S_1) implies (S_3)

- 3.168** The following observation is made about the scores obtained by 100 students in an exam :

'For each student, there exists another student in the class such that their scores are at most ten marks away.'

If the above statement is false, which one of the following statements is necessarily true?

- (A) For each student, the scores of all the other students are more than 10 marks away.
(B) There exists at least one student in the class for whom the scores of all the other students are more than 10 marks away.
(C) There is exactly one student in the class for whom the scores of some students are more than 10 marks away.
(D) For each student, the score of exactly one other student is more than 10 marks away. [EC]

- 3.169** Three children P , Q , R and two grown-ups X , Y play a badminton doubles tournament. X and Y are parents to two of the children playing. The child of X is not the same as the child of Y . Exactly one of the children does not have a parent

playing in the tournament. The following rules are followed: [EC]

- (i) A parent and his/her child cannot be on the same team.
- (ii) A match can feature at most one parent and his/her child, that is, a maximum of one parent-child pair can play in a match.

The following matches were played :

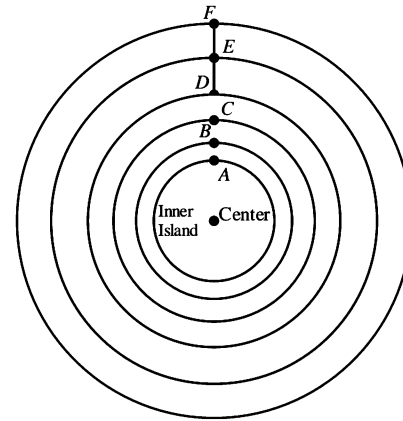
	Team 1	Team 2
Match 1	P and X	Q and R
Match 2	P and R	X and Y
Match 3	R and X	Q and Y

Which one of the following options is correct?

- (A) P does not have any parent playing
- (B) Q does not have any parent playing
- (C) R does not have any parent playing
- (D) X does not have a child playing

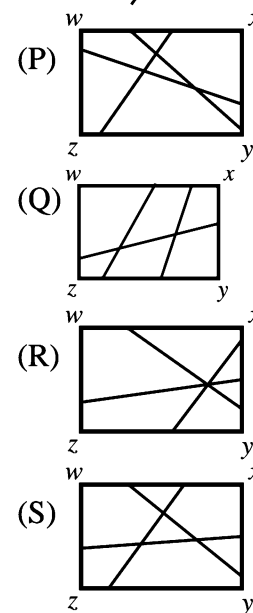
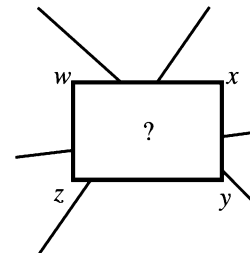
- 3.170** The city of Atlantis was crafted by the God of the seas, Poseidon. It was made of alternating concentric circular rings of land (shaded) and water (not shaded) as represented in the figure (not to scale). The radius of Inner Island was 2.5 stades (a unit of length used in ancient Greece). The water surrounding Inner Island was one stade wide (length AB). This was surrounded by two pairs of alternating rings of land and water. The first pair of land and water was two stades wide each (lengths BC and CD), and the outer pair is three stades wide each (lengths DE and EF).

The ratio of the surface area of the land to that of the water in the city of Atlantis is _____ (round off to two decimal places). [EC]



- (A) 0.45
- (B) 0.60
- (C) 0.75
- (D) 0.90

- 1.171** The figure below has exactly three intersecting line segments with a rectangular portion $WXYZ$ missing. Which one of the following options P , Q , R and S is the missing portion $WXYZ$? [EC]

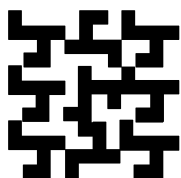


- (A) P
- (B) Q
- (C) R
- (D) S

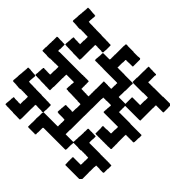
3.172 'If Anish had scored hundred runs in today's match, he would have been made the captain of his team. He would have then become the youngest captain in his team's history. Unfortunately, he got out without scoring any runs. Hence, there won't be any change in the captaincy for now.' Based on the paragraph above, which one of the following statements is true? [EE, PI, CE-1]

- (A) Anish made hundred runs but was denied captaincy.
 (B) Anish was the captain of his team before the game today.
 (C) The current captain is older than Anish.
 (D) Anish is the youngest player in his team.

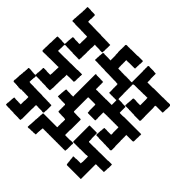
3.173 Which one of the following figures P, Q, R, or S, correctly shows the 45° clockwise-rotated version of figure (I)? [EE, PI, CE-1]



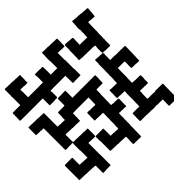
(I)



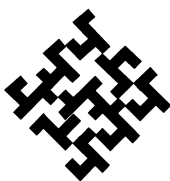
P



Q



R

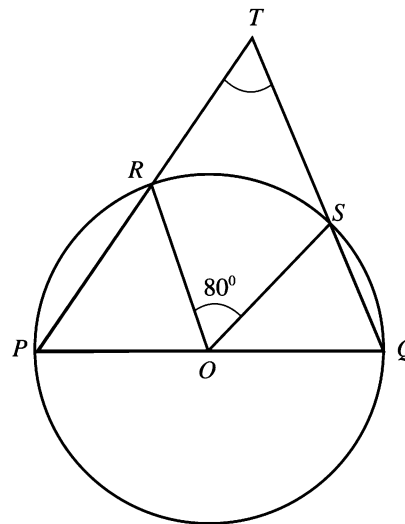


S

- (A) P
(C) R

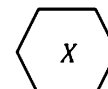
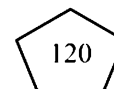
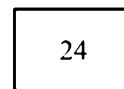
- (B) Q
(D) S

3.174 In the given figure, $\overline{PQ}$ is the diameter of a circle with center O . Two points R and S are chosen on the circle such that $\angle ROS = 80^\circ$. When $\overline{PR}$ and $\overline{QS}$ are extended, they meet at T . The value of $\angle RTS$ is _____. [EE, PI, CE-1]



- (A) 40° (B) 50°
 (C) 60° (D) 80°

3.175 Based on the relationship between each polygon and the number inside it, the value of 'X' is _____. [EE, PI, CE-1]



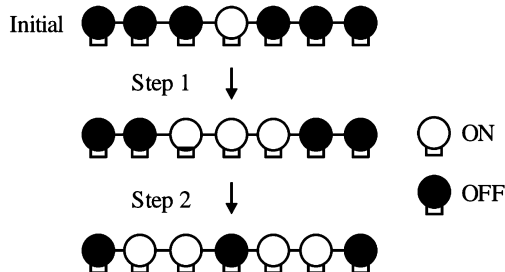
- (A) 720 (B) 596
 (C) 24 (D) 240

3.176 Consider a linear arrangement of seven bulbs, each of which can be in the ON or OFF states. The initial configuration of the bulbs is shown in the figure. In every Step, the states of the bulbs are changed based on the following rules :

- Any OFF bulb with exactly one ON neighbor at the end of the previous Step is turned ON.

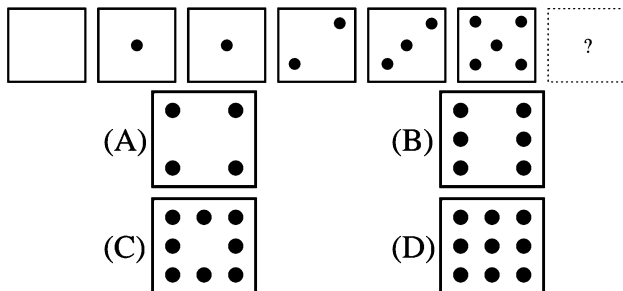
- Any ON bulb with both neighbors ON at the end of the previous Step is turned OFF.
- The state of any bulb not meeting the conditions above is left unchanged.

The state of bulbs at the end of Step 1 and Step 2 are also shown in the figure. The number of bulbs which are ON at the end of Step 8 is _____. [EE, PI, CE-1]

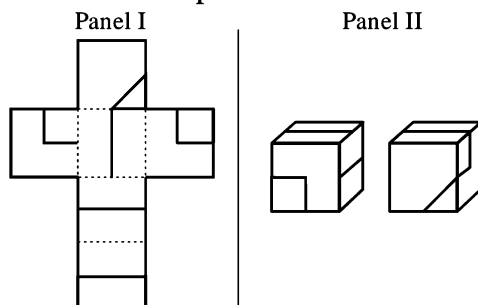


- (A) 5 (B) 4
(C) 3 (D) 0

- 3.177 To continue the sequence of tiles shown, the tile indicated by the question mark should be [IN, XE]



- 3.178 A paper shown in Panel I is folded along the dashed lines (---) to construct a cube. The shaded regions shown in Panel I appear on the outer surface of the cube. Referring to cubes shown in Panel II, which one of the options is correct?



Only (i) can correspond to the unfolded cube in Panel I.

Only (ii) can correspond to the unfolded cube in Panel I.

Both (i) and (ii) can correspond to the unfolded cube in Panel I.

Neither (i) nor (ii) can correspond to the unfolded cube in Panel I. [IN, XE]

- 3.179 In a population, patients who have high cholesterol also have high blood-pressure (BP). Some patients with high BP also have diabetes. There are no patients who have both high cholesterol and diabetes. Furthermore,

- The total number of patients with at least one of these conditions is 75,
- The number of patients with high cholesterol is 10,
- The number of patients with high BP is 45, and
- The number of patients with only high BP and no other conditions is 20.

Then the number of patients who have both diabetes and high BP is. [IN, XE]

- (A) 0 (B) 15
(C) 20 (D) 10

- 3.180 Four people P, Q, R and S, of different ages, make the following observations.

P-I am younger than S.

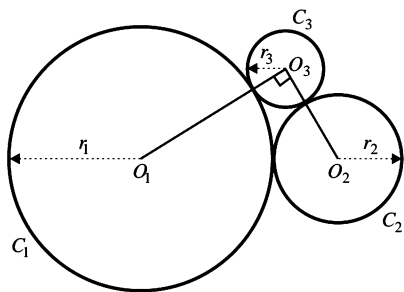
Q-I am neither the youngest nor the oldest.

R - P is older than me.

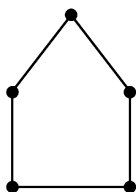
Based on these observations, the youngest person is _____. [IN, XE]

- (A) P (B) Q
(C) R (D) S

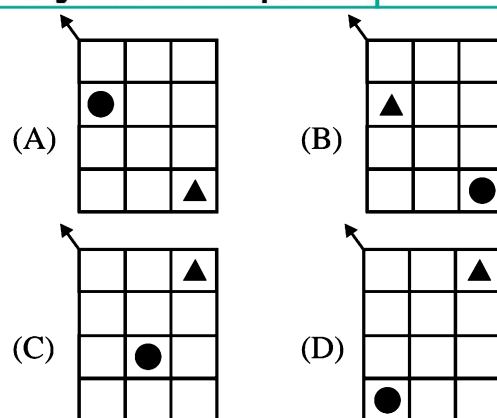
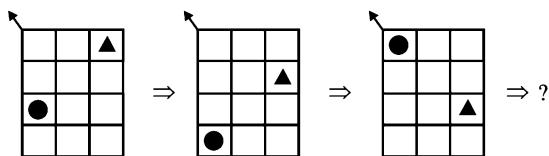
- 3.181** Circles C_1, C_2 and C_3 , with centres O_1, O_2 and O_3 and radii r_1, r_2 and r_3 , respectively, touch each other as shown in the following figure. Given $r_1 = 2$ cm, $r_2 = 1$ cm and the angle $\angle O_1 O_3 O_2$ is 90° , $r_3 =$ _____ cm. [IN, XE]



- (A) $\frac{1}{2}(-3 + \sqrt{17})$ (B) $\frac{1}{2}(3 + \sqrt{17})$
 (C) $\frac{1}{2}(-2 + \sqrt{17})$ (D) $\frac{1}{2}(-3 + 2\sqrt{17})$
- 3.182** Consider an art gallery whose walkways are shown as lines in the diagram. A black dot represents a junction of two walkways. A guard may be placed at a junction to watch over the walkways that join at that junction. The minimum number of guards needed to watch all the walkways is _____. [IN, XE]



- (A) 2 (B) 3
 (C) 4 (D) 5
- 3.183** The next figure (indicated by '?') in the sequence is [CE-2, ME]



- 3.184** 'All the mangoes in the basket are good.' [CE-2, ME]

If the above statement is false, then which one of the following statements is necessarily true?

- (A) All the mangoes in the basket are not good.
 (B) No mango in the basket is good.
 (C) In the basket, some of the mangoes are good and some are not good.
 (D) There exists at least one mango in the basket that is not good.
- 3.185** Consider the following statements about four numbers : [CE-2, ME]

(S1) The average of the four numbers is 25
 (S2) Each number is at most 40
 (S3) Each number is at least 20
 Choose the option that is necessarily correct.

- (A) (S1) and (S2) together imply (S3)
 (B) (S2) and (S3) together imply (S1)
 (C) (S1) and (S3) together imply (S2)
 (D) (S1) implies (S3)

- 3.186** The Roman senator Meritorius, his brother, his son, and his daughter have varying oratory skill levels. They are seated in rows and columns as shown in the figure with exactly one person sitting in each box. It is known that

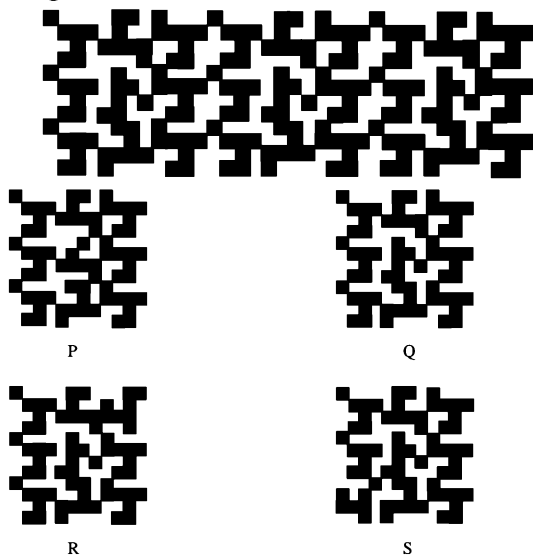
- (i) Meritorius' daughter and his brother are seated in the same column.
 (ii) His son is seated diagonally across the sibling of the worst orator.
 (iii) The best and worst orators are seated in the same row.

Who is the best orator? [CE-2, ME]

	Seating Arrangement	
	Column 1	Column 2
Row 1		
Row 2		

- (A) Meritorius
 (B) Meritorius' brother
 (C) Meritorius' son
 (D) Meritorius' daughter

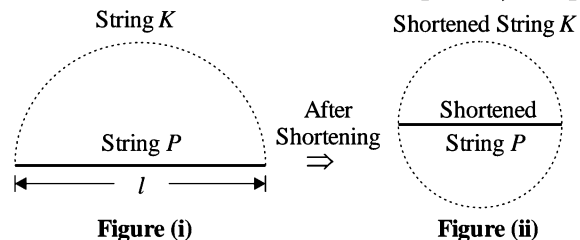
- 3.187 Which one of the patterns labelled P, Q, R, and S is used to generate the following figure? [CE-2, ME]



- (A) P (B) Q
 (C) R (D) S

- 3.188 Consider a string P of length l that is laid out as a straight-line segment. Another string K is laid out as a semicircular arc with string P as its diameter, as

represented in Figure (i). When both the strings are shortened by a length x they can be re-arranged such that the shortened string K forms a full circle with the shortened string P as its diameter, as represented in Figure (ii). The value of x/l is _____. [CE-2, ME]

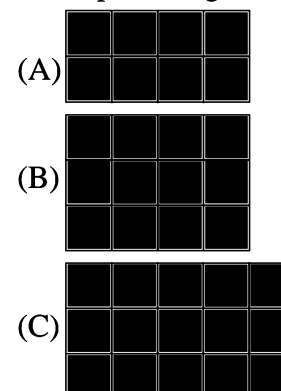


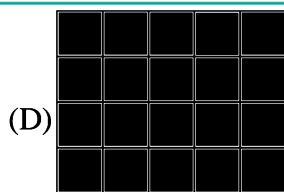
- (A) π (B) $\frac{\pi-1}{2\pi}$
 (C) $\frac{\pi}{2(\pi-1)}$ (D) $\frac{\pi}{\pi-1}$

- 3.189 The figure shows two 4-tile patterns.



Either one or both of the patterns can be used any number of times and in any orientation to construct a new pattern. Which one of the options below cannot be constructed by using only these two 4-tile patterns assuming there are no overlaps among them? [CS-1]





- 3.190** In the 2020 summer Olympics' Javelin throw finals, Neeraj Chopra exhibited a spectacular performance to win the gold medal. The silver medal was won by Jakub Vadlejch and the bronze medal was won by Vitezlav Vesely. There were six rounds of throws with each athlete having one throw per round. The best of all the throws of each athlete is considered for the medal. [CS-1]

Following were the observations about the throws :

The first and second rounds were dominated by Neeraj Chopra with a gold medal performance in his second throw, while the other two athletes did not have any medal winning throws in these rounds.

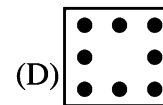
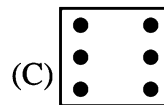
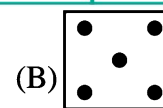
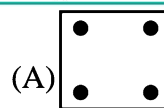
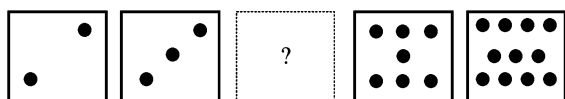
The throws in the last round by both Jakub Vadlejch and Vitezlav Vesely were fouls and were not considered for scoring.

After four rounds, Vitezlav Vesely was in the second position and could not improve upon his best throw in the succeeding rounds.

In the fourth round, the throw by Jakub Vadlejch was the best in that round.

- (A) Third (B) Fourth
(C) Fifth (D) Sixth

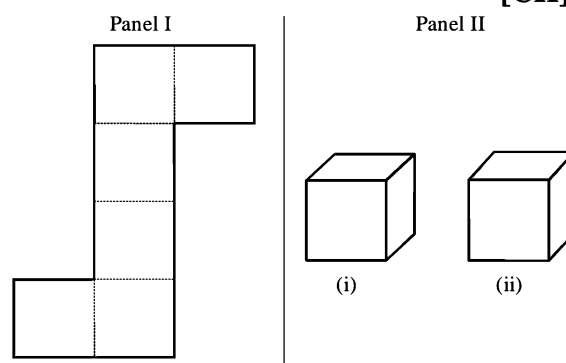
- 3.191** In the sequence of tiles shown below, the missing tile indicated by the question mark should be [CH]



- 3.192** A school has 100 students distributed among 1st to 10th standards. Based on this, which one of the following statements is always correct ? [CH]

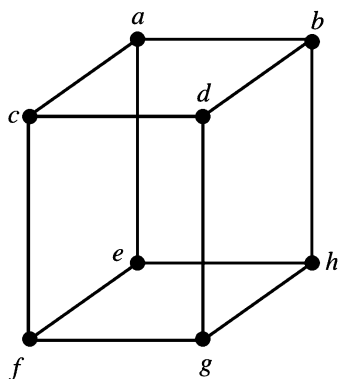
- (A) There are at least 10 students who belong to the same standard.
(B) There is at least one student in each standard.
(C) There are at most 10 students in 10th standard.
(D) The total number of students from 1st to 5th standards is at least 50.

- 3.193** A paper shown in Panel I is folded along the dashed lines (---) to construct a cube. The shaded regions shown in Panel I appear on the outer surface of the cube. Referring to cubes shown in Panel II, which one of the options is correct ? [CH]



- (A) Only (i) can correspond to the unfolded cube in Panel I.
(B) Only (ii) can correspond to the unfolded cube in Panel I.
(C) Both (i) and (ii) can correspond to the unfolded cube in Panel I.
(D) Neither (i) nor (ii) can correspond to the unfolded cube in Panel I.

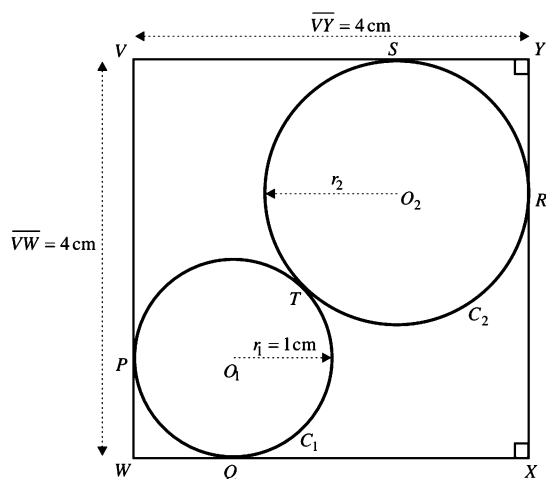
- 3.194** Consider the cube shown below with its 8 corners labelled a, b, c, d, e, f, g, and h. The figure is representative. All corners are to be colored such that any two corners that are connected by an edge must be of different colors. The minimum number of colors required to achieve this is _____. [CH]



- (A) 8 (B) 4
(C) 3 (D) 2
- 3.195** As shown in the figure, circle with center O_1 and radius r_1 touches the VWXY at points P and Q while circle C_2 with center O_2 and radius r_2 touches the square VWXY at points R and S. The two circles touch each other at T.

Given : $r_1 = 1\text{cm}$ and

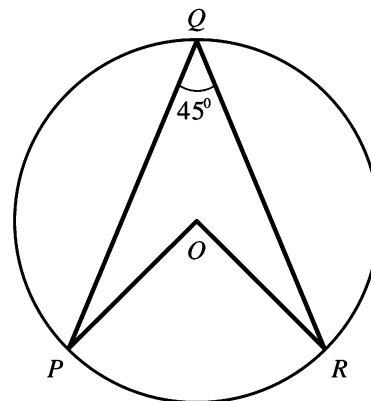
$\overline{VY} = 4\text{cm}$, $r_2 =$ _____ cm [CH]



- (A) $4 - 3\sqrt{2}$ (B) $1 + 2\sqrt{2}$
(C) $7 - 4\sqrt{2}$ (D) $5 + 3\sqrt{2}$

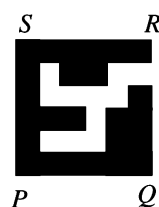
- 3.196** In the given figure, P, Q and R are three points on a circle of radius 10 cm with O as its center, $\overline{PQ} = \overline{RQ}$ and $\angle PQR = 45^\circ$. The figure C_1 is representative.

The area of the shaded region PQRO is _____ cm^2 . [DA]



- (A) 50 (B) $25\sqrt{2}$
(C) $50\sqrt{2}$ (D) 100
- 3.197** A black square PQRS has been cut into two parts. One part of it is shown in Panel I. Which one of the shapes in Panel II is the other part? [CS-2]

Panel I



Panel II



(i)



(ii)



(iii)

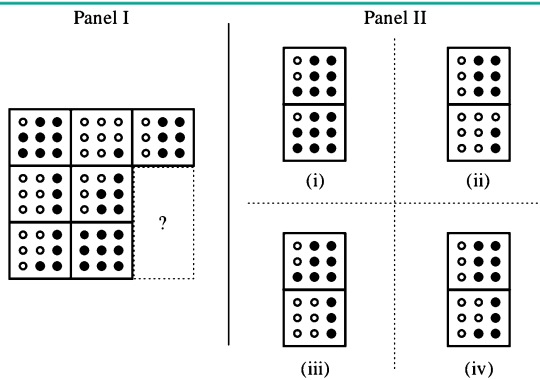


(iv)

- (A) (i) (B) (ii)
(C) (iii) (D) (iv)

- 3.198** Two tiles are missing in Panel I. Which one of the options in Panel II is the appropriate choice for the missing tiles?

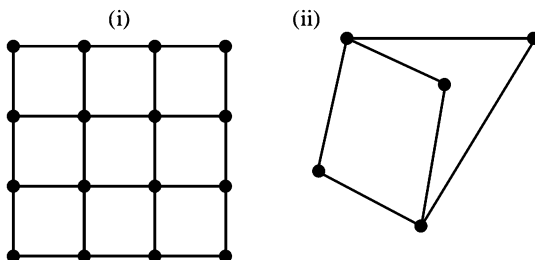
[CS-2]



- (A) (i) (B) (ii)
(C) (iii) (D) (iv)

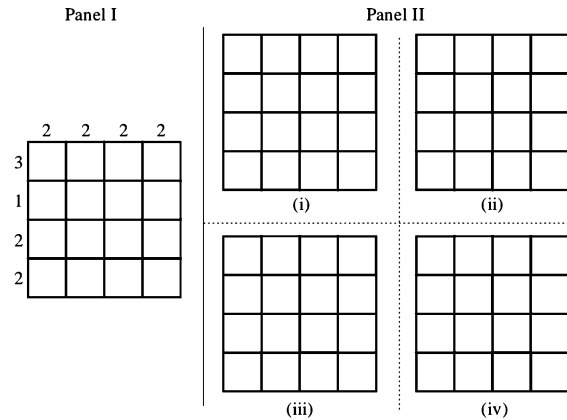
- 3.199** Figures (i) and (ii) represent intercity highway systems. The black dots represent cities and the line segments between them represent intercity highways. A salesperson needs to make a trip. She needs to start from a city, visit each of the remaining cities exactly once, and finally return to the same city from which she started.

Which one of the following options is then true?
[CS-2]



- (A) Such a trip is possible for (i), but not for (ii).
(B) Such a trip is possible for (ii), but not for (i).
(C) Such a trip is possible for both (i) and (ii).
(D) Such a trip is possible neither for (i) nor for (ii).
- 3.200** The figure in Panel I below is a grid of cells with four rows and four columns. The numbers on the top and on the left represent the number of cells that are to

be shaded in that column and row, respectively. Which one of the options shown in Panel II below represents the grid shaded correctly?
[CS-2]



- (A) (i) (B) (ii)
(C) (iii) (D) (iv)

Engineering Services Examination (ESE)

- 1.** Circle A is 4 cm in diameter, circle B is 5 cm in diameter. Circle C has its circumference equal to the sum of the circumferences of both A and B together. What will be the ratio of the area of circle C , with respect to the area of circle A and circle B respectively?
(A) 5.0625 and 1.84 (B) 3.875 and 1.84
(C) 5.0625 and 3.24 (D) 3.875 and 3.24

[ESE 2018]

- 2.** A wall, rectangular in shape, has a perimeter of 72 m. If the length of its diagonal is 18 m, what is the area of the wall?
(A) 224 m² (B) 486 m²
(C) 572 m² (D) 606 m²

[ESE 2018]

- 3.** Consider the length of a room is 15 m and width is 10 m. If the sum of the areas of the floor and ceiling is equal to the sum of the areas of the four walls, then volume of the room is

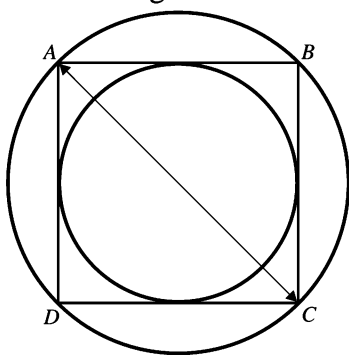
- (A) 900 m^3 (B) 1000 m^3
 (C) 1200 m^3 (D) 1500 m^3

[ESE 2018]

4. In two concentric circles, a chord length 80 cm of larger circle becomes a tangent to the smaller circle whose radius is 9 cm. The radius of the larger circle will be :
 (A) 13 cm (B) 41 cm
 (C) 52 cm (D) 75 cm

[ESE 2019]

5. Consider following diagram : AC is a diameter of the large circle and $AB = BC$.

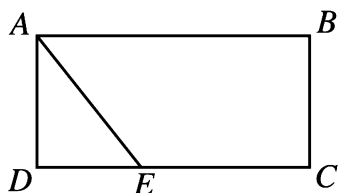


The ratio of areas of the large circle to the small circle of a square is :

- (A) 4 : 1 (B) 1 : 4
 (C) 2 : 1 (D) 1 : 2

[ESE 2019]

6. Consider the rectangle ABCD with $DE = \frac{1}{3}DC$ in the figure :



When the area of the triangle ADE is 20 cm^2 , the area of the rectangle ABCD will be

- (A) 60 cm^2 (B) 80 cm^2
 (C) 100 cm^2 (D) 120 cm^2

[ESE 2020]

7. Four metal rods of lengths 78 cm, 104 cm, 117 cm and 169 cm are to be cut into parts of equal length. Each part must be as long as possible. The maximum number of pieces that can be cut will be :
 (A) 27 (B) 36
 (C) 43 (D) 52

[ESE 2020]

8. The diagonal of a rectangle is $\sqrt{41}$ cm and its area is 20 sq.cm. The perimeter of the rectangle is
 (A) 9 cm (B) 18 cm
 (C) 20 cm (D) 41 cm

[ESE 2021]

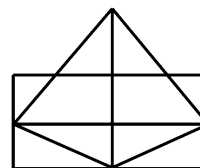
9. Mary introduces Jack as the son of the only daughter of my father's wife. How is Jack related to Mary ?
 (A) Brother (B) Son
 (C) Husband (D) Father

[ESE 2021]

10. If $A \times B$ means $(A^2 + B^2)$, then the value of $5 \times (4 \times 3)$ is
 (A) 60 (B) 300
 (C) 650 (D) 710

[ESE 2021]

11. The number of triangles in the given figure is



- (A) 11 (B) 13
 (C) 15 (D) 17

[ESE 2021]

12. If $\frac{x+1}{x-1} = \frac{a}{b}$ and $\frac{1-y}{1+y} = \frac{b}{a}$, then the value of $\frac{x-y}{1+xy}$ is

$$(A) \frac{2ab}{a^2 - b^2} \quad (B) \frac{a^2 - b^2}{2ab}$$

$$(C) \frac{a^2 + b^2}{2ab} \quad (D) \frac{a^2 - b^2}{ab}$$

[ESE 2021]

13. If $(2x+3y):(3x+5y)=18:29$, then the value of $x:y$ is

- (A) 4:1 (B) 4:5
(C) 3:4 (D) 3:1

[ESE 2021]

14. One side of a rhombus is 10 cm and one of its diagonals is 12 cm. The area of the rhombus is

- (A) 24 sq.cm (B) 48 sq.cm
(C) 72 sq.cm (D) 96 sq.cm

[ESE 2022]

15. Two boys begin together to write out a booklet containing 817 lines. The first boy starts with first line, writing at the rate of 200 lines an hour and the second boy starts with the last line. He writes line 817 and so on backwards proceeding at the rate of 150 lines an hour. At what line will they meet?

- (A) 469th (B) 467th
(C) 465th (D) 463rd

[ESE 2022]

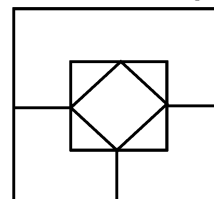
16. Suppose you enter an elevator at a certain floor. Then the elevator moves up 5 floors, down 3 floors, and up 2 floors. If you are then at the 8th floor, on what floor did you first enter the elevator?

- (A) 8 (B) 7
(C) 6 (D) 9

[ESE 2023]

17. The soccer club is putting together a mural using lightly colored transparent paper. This paper then is cut into squares of different sizes that are placed next to

each other to make the designs for the mural. Of course, the club wants to save money, so its members are trying to buy the minimum number of sheets of colored paper. Below is one of the designs they are going to use. What is the minimum number of squares they will need to make this design?



- (A) 4 (B) 5
(C) 6 (D) 7

[ESE 2023]

18. Nothing is known about the personal life of the ancient Greek mathematician Diophantus except for the information in the following:

“Diophantus passed $\frac{1}{6}$ of his life in childhood, $\frac{1}{12}$ in youth, and $\frac{1}{7}$ more as a bachelor. Five years after his marriage was born a son who died four years before his father, at $\frac{1}{2}$ his father's (final age.” How old was Diophantus when he died?

- (A) 64 (B) 54
(C) 74 (D) 84

[ESE 2024]

19. In a triangle ABC, if the values of $a=3, b=4$ and $\sin A = \frac{3}{4}$, then the angle $\angle B$ will be

- (A) 30° (B) 45°
(C) 60° (D) 90°

[ESE 2025]

20. In an area of an ellipse, if one percent error is made in measuring the major and minor axis, the percentage error will be
 (A) 2% (B) 3%
 (C) 4% (D) 5%

[ESE 2025]

21. The bond that is formed between water molecules due to attraction between the positively-charged hydrogen end of a molecule and the negatively-charged oxygen end of another molecule is called
 (A) Hydrogen bond (B) Covalent bond
 (C) Ionic bond (D) Metallic bond

[ESE 2025]

22. The capacity of a material to absorb energy when it is deformed elastically and then, upon unloading, to have this energy recovered is called
 (A) Toughness
 (B) Resilience
 (C) Modulus of elasticity
 (D) Yielding

[ESE 2025]

23. Which one of the following is the correct sequence of e-Governance evolution model ?

- (A) Information, Transaction, Transformation and Interaction
 (B) Information, Transaction, Interaction and Transformation
 (C) Information, Transformation, Transaction and Interaction
 (D) Information, Interaction, Transaction and Transformation

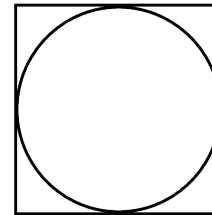
[ESE 2025]

24. Which one of the following attack methods is originally developed as a rapid method to conduct many different IP-based DoS attacks ?

- (A) Nestea (B) Packet storms
 (C) Teardrop (D) Targa

[ESE 2025]

25. Following figure represents a circle inside a square. What does the diagram establish ?



- (A) $\pi < 4$ (B) $\pi > 3$
 (C) $\pi > 2$ (D) $\pi \geq 2\sqrt{2}$

[ESE 2026]

26. A rectangular area of side 9 and 6 units is to be covered by square tiles of sides 1, 2 and 5 units. The minimum number of tiles needed for this is

- (A) 13 (B) 11
 (C) 12 (D) 15

[ESE 2026]

Answers

Numerical Computation

3.1	C	3.2	A	3.3	A	3.4	B	3.5	C
3.6	D	3.7	B	3.8	A	3.9	A	3.10	B
3.11	C	3.12	C	3.13	C	3.14	B	3.15	B
3.16	B	3.17	A	3.18	B	3.19	280	3.20	A
3.21	D	3.22	6	3.23	D	3.24	C	3.25	180
3.26	C	3.27	8	3.28	B	3.29	C	3.30	C
3.31	B	3.32	B	3.33	B	3.34	B	3.35	A
3.36	C	3.37	D	3.38	B	3.39	B	3.40	D
3.41	B	3.42	A	3.43	C	3.44	B	3.45	C
3.46	D	3.47	D	3.48	B	3.49	C	3.50	A
3.51	D	3.52	C	3.53	D	3.54	B	3.55	C
3.56	C	3.57	D	3.58	B	3.59	B	3.60	C
3.61	B	3.62	B	3.63	A	3.64	A	3.65	C
3.66	C	3.67	D	3.68	A	3.69	D	3.70	D
3.71	C	3.72	A	3.73	A	3.74	A	3.75	A
3.76	B	3.77	D	3.78	D	3.79	C	3.80	B
3.81	C	3.82	C	3.83	A	3.84	D	3.85	B
3.86	C	3.87	C	3.88	C	3.89	C	3.90	D
3.91	C	3.92	C	3.93	B	3.94	A	3.95	C
3.96	B	3.97	C	3.98	C	3.99	D	3.100	A
3.101	A	3.102	C	3.103	A	3.104	C	3.105	D
3.106	C	3.107	C	3.108	C	3.109	B	3.110	B
3.111	D	3.112	A	3.113	C	3.114	A	3.115	B
3.116	A	3.117	B	3.118	C	3.119	D	3.120	D
3.121	D	3.122	A	3.123	A	3.124	C	3.125	C
3.126	D	3.127	A	3.128	D	3.129	MTA	3.130	B
3.131	A	3.132	B	3.133	A	3.134	A	3.135	C
3.136	A	3.137	MTA	3.138	D	3.139	A	3.140	A
3.141	C	3.142	A	3.143	A	3.144	A	3.145	A
3.146	B	3.147	A	3.148	D	3.149	A	3.150	A
3.151	A	3.152	D	3.153	A	3.154	C	3.155	B
3.156	C	3.157	B	3.158	C	3.159	C	3.160	D
3.161	B	3.162	C	3.163	B	3.164	B	3.165	C
3.166	C	3.167	A	3.168	B	3.169	C	3.170	C

3.171	D	3.172	C	3.173	B	3.174	B	3.175	A
3.176	B	3.177	C	3.178	B	3.179	B	3.180	C
3.181	A	3.182	B	3.183	A	3.184	D	3.185	C
3.186	B	3.187	B	3.188	C	3.189	C	3.190	A
3.191	B	3.192	A	3.193	A	3.194	D	3.195	C
3.196	C	3.197	C	3.198	A	3.199	A	3.200	B

Engineering Services Examination (ESE)

1.	C	2.	B	3.	A	4.	B	5.	C
6.	D	7.	B	8.	B	9.	B	10.	C
11.	C	12.	A	13.	C	14.	D	15.	B
16.	*	17.	B	18.	D	19.	D	20.	A
21.	A	22.	B	23.	D	24.	D	25.	*
26.	*								

Explanations

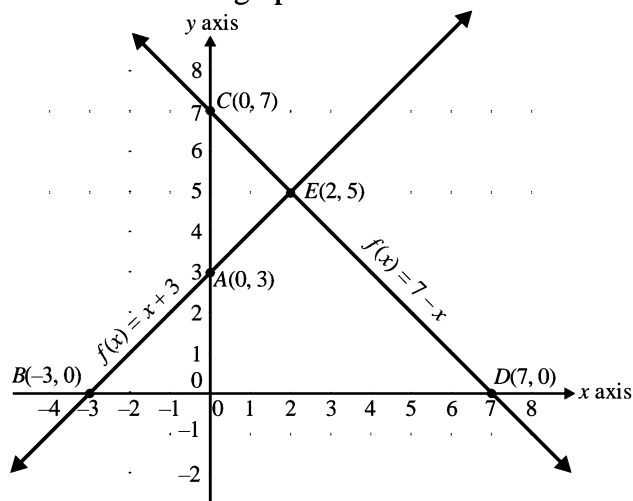
Numerical Computation

3.1 (C)

Given :

$$y = f(x) = \max(7 - x, x + 3) \dots (i)$$

We can draw the graph.



To find intersection point we can equate the two lines

$$7 - x = x + 3$$

$$2x = 4$$

$$x = 2$$

If we put $x = 2$ in equation (i)We will get $y = 5$ Intersection point $(x, y) = (2, 5)$ Among the all given options only option (C) range includes $x = 2$.

Hence, the correct option is (C).

3.2 (A)

Given : $f_1(n) = n^{100}$

$$f_2(n) = (1.2)^n$$

$$f_3(n) = (2)^{n/2} = (1.414)^n$$

$$f_4(n) = (3)^{n/3} = (1.442)^n$$

We know that $(1.442)^n > (1.414)^n$ and

$$(1.442)^n > (1.2)^n$$

Therefore, $f_4(n)$ is greater than both $f_2(n)$ and $f_3(n)$.Now, we have to check between $f_4(n)$ and $f_1(n)$.But $f_1(n)$ is a polynomial function and $f_4(n)$ is an exponential function. Any exponential function will have larger value than any

polynomial function for sufficiently large value of input. So, $f_4(n)$ has the largest value here.

Hence, the correct option is (A).

3.3 (A)

Given : $X_1 \geq 0$... (i)

$X_2 \geq 0$... (ii)

$X_1 + X_2 \leq 10$... (iii)

$2X_1 + 2X_2 \geq 22$... (iv)

Now, the equation (iv) can be written as

$X_1 + X_2 \geq 11$... (v)

Now, equations (iii) and (v) cannot hold true together since $X_1 \geq 0$ and $X_2 \geq 0$.

Hence, system of inequalities can never be satisfied.

Hence, the correct option is (A).

3.4 (B)

Given :

In inequality we should not do cross multiplication as we do not know the sign of y (we know that on multiplying with negative number inequality will change).

$$\frac{2y+1}{y+2} < 1$$

$$\frac{2y+1}{y+2} - 1 < 0$$

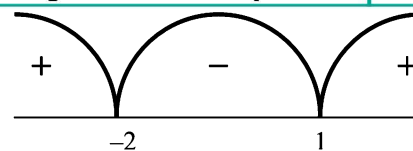
$$\frac{y-1}{y+2} < 0$$

Since, $\frac{y-1}{y+2} = +ve$ for $y < -2$

$$\frac{y-1}{y+2} = +ve \text{ for } y > 1$$

$$\frac{y-1}{y+2} = -ve \text{ for } -2 < y < 1$$

We can draw the following number line



Since, we are getting negative interval for $y \in (-2, 1)$

Hence, the correct option is (B).

3.5 (C)

If equation is $ax^2 + bx + c = 0$ and roots of the equation are x_1 and x_2

In the first attempt "He incorrectly wrote the constant term and ended up with the roots as (4, 3)"

Equation will be $ax^2 + bx + c = 0$

$$(x-4)(x-3) = 0$$

$$x^2 - 7x + 12 = 0$$

Here, $a = 1$ and $b = -7$, c is incorrect as given.

Since, sum of roots

$$\begin{aligned} &= -\frac{b}{a} \\ &= \frac{7}{1} \end{aligned} \quad \dots (i)$$

In the second attempt "He incorrectly wrote down the coefficient of x and got the roots as (3, 2)"

Equation will be $ax^2 + bx + c = 0$

$$(x-3)(x-2) = 0$$

$$x^2 - 5x + 6 = 0$$

Here, $a = 1$, $c = 6$, b is incorrect as given.

Since, product of roots

$$\begin{aligned} &= \frac{c}{a} \\ &= \frac{6}{1} \end{aligned} \quad \dots (ii)$$

With the help of equation (i) and (ii)

New equation,

$$ax_1^2 + bx_1 + c = 0$$

$$x_1^2 - 7x_1 + 6 = 0$$

$$x_1^2 - 6x_1 + x_1 + 6 = 0$$

$$x_1(x_1 - 6) - 1(x_1 - 6) = 0$$

$$(x_1 - 1)(x_1 - 6) = 0$$

$$x_1 = 1, x_1 = 6$$

Hence, the correct option is (C).

3.6 (D)

Given : $f(y) = \frac{|y|}{y}$

Since, $|y| = \begin{cases} y & y \geq 0 \\ -y & y < 0 \end{cases} \quad \dots(i)$

$$|f(q) - f(-q)| = \left| \frac{|q|}{q} - \frac{|-q|}{(-q)} \right| = \left| \frac{|q|}{q} + \frac{|q|}{q} \right|$$

$$|f(q) - f(-q)| = \left| \frac{2|q|}{q} \right|$$

For $q > 0$,

$$|f(q) - f(-q)| = \left| \frac{2 \times q}{q} \right| = 2$$

For $q < 0$,

$$|f(q) - f(-q)| = \left| \frac{2 \times q}{-q} \right| = 2$$

Hence, the correct option is (D).

3.7 (B)

Let $\log P = \frac{1}{2} \log Q = \frac{1}{3} \log R = K$

$$P = 10^K, Q = 10^{2K}, R = 10^{3K}$$

$$Q^2 = 10^{4K}$$

$$P \times R = 10^{4K}$$

So, $Q^2 = PR$

Hence, the correct option is (B).

3.8 (A)

Given :

(i) Variable cost, $V = 4q$

(ii) Fixed cost, $F = \frac{100}{q}$

Total cost, $c = V + F = 4q + \frac{100}{q}$

Differentiating above equation,

$$\frac{dc}{dq} = 4 - \frac{100}{q^2}$$

Condition of minima : $\frac{d^2c}{dq^2} = +ve$

$$\frac{dc}{dq} = 4 - \frac{100}{q^2}$$

Stationary point is given by,

$$\frac{dc}{dq} = 0$$

$$q = \pm 5$$

$$\frac{d^2c}{dq^2} = 0 + \frac{200}{q^3}$$

At $q = 5$,

$$\frac{d^2c}{dq^2} = 1.6(+ve)$$

At $q = -5$,

$$\frac{d^2c}{dq^2} = -1.6(-ve)$$

Therefore, at $q = 5$, the total cost will be minimum.

Hence, the correct option is (A).

3.9 (A)

Given :

(i) Cost function of a product $= 5q^2$

(ii) Selling price $= 50/\text{unit}$

For q number of units, selling price function $= 50q$

Total profit = Selling function – cost function

$$P = 50q - 5q^2$$

For maximum profit : $\frac{d^2P}{dq^2} = -ve$

$$\frac{dP}{dq} = 50 - 10q$$

Stationary point is given by,

$$\frac{dP}{dq} = 50 - 10q = 0$$

$$q = 5$$

$$\frac{d^2P}{dq^2} = 0 - 10 = -10 (-ve)$$

Therefore, for maximum profit, total number of units produced is 5.

Hence, the correct option is (A).

3.10 (B)

Given : $y = 2x - 0.1x^2$

Condition for maximum height of arch :

$$\frac{d^2y}{dx^2} = -ve$$

$$\frac{dy}{dx} = 2 - 0.2x$$

Stationary point is given by,

$$\frac{dy}{dx} = 0$$

$$2 - 0.2x = 0$$

$$x = 10 \text{ meters}$$

$$\frac{d^2y}{dx^2} = 0 - 0.2 = -0.2 = -ve$$

The condition of maxima is satisfied

The maximum height of the arch at $x = 10$ m is given by,

$$y|_{x=10} = 2 \times 10 - 0.1 \times (10)^2$$

$$y|_{x=10} = 10 \text{ meters}$$

Hence, the correct option is (B).

3.11 (C)

Let us take an example of a list as shown below,

$$\text{list}(x) = \{1, 2, 3\}$$

P : Adding 7 to each entry in a list adds 7 to the mean of the list.

$$\text{Mean}(\bar{x}) = \frac{1+2+3}{3} = 2$$

$$\text{Mean}' = \frac{(1+7) + (2+7) + (3+7)}{3} = 9$$

$$\text{Mean}' = \text{Mean} + 7$$

Assertion 'P' is correct.

Q : Adding 7 to each entry in a list adds 7 to the standard deviation of the list.

$$\text{Standard deviation} = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

$$\sigma = \sqrt{\frac{(1-2)^2 + (2-2)^2 + (3-2)^2}{3}}$$

$$\sigma = \sqrt{\frac{2}{3}} = 0.816$$

$$\sigma' = \sqrt{\frac{(1+7-2)^2 + (2+7-2)^2 + (3+7-2)^2}{3}}$$

$$\sigma' = \sqrt{\frac{149}{3}} = 7.047$$

$$\sigma' \neq \sigma + 7$$

This assertion is incorrect.

R : Doubling each entry in a list doubles the mean of the list.

$$\text{Mean}' = \frac{2 \times 1 + 2 \times 2 + 2 \times 3}{3}$$

$$\text{Mean}' = 4 = 2 \times \text{Mean}$$

This assertion is correct.

S : Doubling each entry in a list leaves the standard deviation of the list unchanged.

$$SD' = \sqrt{\frac{\sum (2x - \bar{x})^2}{n}}$$

$$SD' = \sqrt{\frac{(2-2)^2 + (2 \times 2 - 2)^2 + (2 \times 3 - 2)^2}{3}}$$

$$SD' = \sqrt{\frac{20}{3}} \neq \sigma$$

This assertion is also incorrect.

Hence, the correct option is (C).

3.12 (C)

Given : $f(x) = x - [x]$

$f(x)$ gives nothing but the fractional part of x .

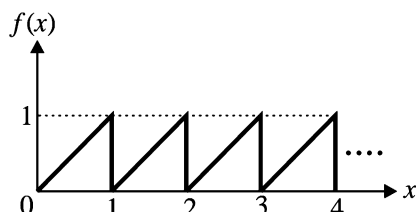
Now, as we move up the number line between two consecutive integers say a and $a+1$.

The value of $f(a)$ starts from 0 and grows linearly till the consecutive integer and just before $x = a+1$ (left neighborhood of $a+1$) it tends to the value 1.

Between a and $a+1$, the graph increase lineally from 0 to 1.

But, when $x = a+1$, the value comes back to 0 and same linear graph continues between the next two consecutive integers and so on.

We can also draw the function $f(x)$, for $x \geq 0$



So, $f(x)$ is a linearly increasing function between two integers.

Hence, the correct option is (C).

3.13 (C)

Given :

For two points

$$(4, p) = (x_1, y_1)$$

$$(0, q) = (x_2, y_2) \text{ on a line,}$$

$$\text{Slope of line} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{So, } \frac{q-p}{0-4} = \frac{3}{4}$$

$$p-q=3$$

Hence, the correct option is (C).

3.14 (B)

Given : $3x^2 + 2x + p(p-1) = 0$

The above equation is quadratic equation of the following form,

$$ax^2 + bx + c = 0$$

Here, $a = 3$, $b = 2$, $c = p(p-1)$.

If the two roots are of different signs, their product must be negative.

$$\text{So, } \frac{c}{a} < 0$$

$$\frac{p(p-1)}{3} < 0$$

$$p(p-1) < 0$$

Either $p < 0$ and $p-1 > 0$

$$p < 0 \text{ and } p > 1 \text{ (not possible)}$$

Or $p > 0$ and $p-1 < 0$

$$p > 0 \text{ and } p < 1$$

$$0 < p < 1 \text{ (possible)}$$

Therefore, the required interval is (0, 1).

Hence, the correct option is (B).

3.15 (B)

Given :

$$(i) \quad \text{Range of } X : 3 \leq X \leq 5 \quad \dots (i)$$

$$(ii) \quad \text{Range of } Y : 8 \leq Y \leq 11$$

$$8 \leq Y \leq 11 \Rightarrow \frac{1}{11} \leq \frac{1}{Y} \leq \frac{1}{8} \quad \dots (ii)$$

From equation (i) and (ii),

$$\frac{3}{11} \leq \frac{X}{Y} \leq \frac{5}{8}$$

Hence, the correct option is (B).

3.16 (B)**Given :** $|-2X + 9| = 3$

$$-2X + 9 = 3 \text{ or } -2X + 9 = -3$$

When $-2X + 9 = 3$

$$X = 3$$

When $-2X + 9 = -3$

$$X = 6$$

For $X = 3$,

$$|-X| - X^2 = |-3| - 3^2 = -6$$

For $X = 6$,

$$|-X| - X^2 = |-6| - 6^2 = -30$$

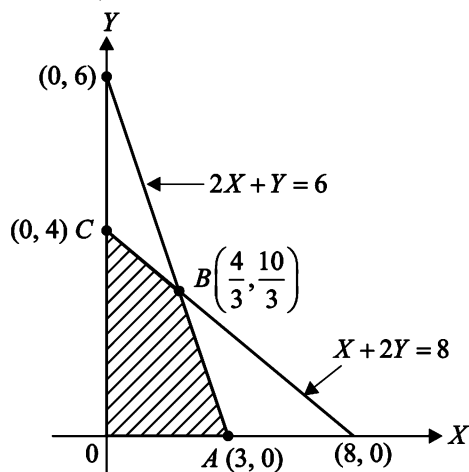
Hence, the correct option is (B).

3.17 (A)**Given :** $f(X, Y) = 3X + 6Y$ where, X and Y are positive real numbers with

$$2X + Y \leq 6 \quad \dots(i)$$

$$X + 2Y \leq 8 \quad \dots(ii)$$

According to the given data following plot is drawn below,

Feasible region $\rightarrow (O - A - B - C - O)$

Only the points lying on the boundary of the feasible region (i.e. point A, B and C) are considered only because at one of these points the value of function $f(X, Y) = 3X + 6Y$ is maximum.

At point A(3, 0) :

$$f(X, Y) = 3 \times 3 + 6 \times 0 = 9$$

At point B $\left(\frac{4}{3}, \frac{10}{3}\right)$:

$$f(X, Y) = 3 \times \frac{4}{3} + 6 \times \frac{10}{3} = 24$$

At point C(0, 4) :

$$f(X, Y) = 3 \times 0 + 6 \times 4 = 24$$

The maximum value is 24, at the point B $\left(\frac{4}{3}, \frac{10}{3}\right)$

and C(0, 4).

Hence, the correct option is (A).

3.18 (B)**Given :** $|4X - 7| = 5$

Here, due to modulus, two possibilities are there,

$$(i) \quad 4X - 7 = 5$$

$$X = 3$$

$$(ii) \quad 4X - 7 = -5$$

$$X = 0.5$$

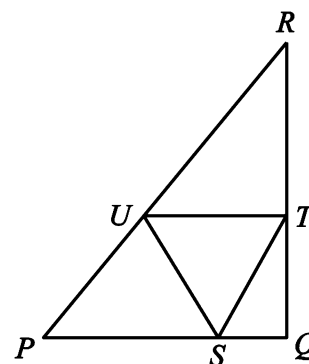
At $X = 3$,

$$2|3| - |-3| = 2 \times 3 - 3 = 3$$

At $X = 0.5$,

$$2|0.5| - |-0.5| = 2 \times 0.5 - 0.5 = 0.5$$

Hence, the correct option is (B).

3.19 280**Given :**

$$\frac{PS}{QS} = \frac{3}{1} = k_1 \text{ (let)}$$

$$PS = 3k_1, QS = k_1$$

$$\frac{RT}{QT} = \frac{5}{2} = k_2 \text{ (let)}$$

$$RT = 5k_2, QT = 2k_2$$

Area of triangle $QTS = 20 \text{ cm}^2$

$$\frac{1}{2} \times 2k_2 \times k_1 = 20$$

$$k_1 k_2 = 20 \quad \dots(i)$$

Area of triangle,

$$\Delta PQR = \frac{1}{2} \times PQ \times QR \quad \dots(ii)$$

From figure,

$$PQ = PS + QS = 3k_1 + k_1 = 4k_1$$

$$QR = QT + RT = 2k_2 + 5k_2 = 7k_2$$

From equation (ii),

$$\Delta PQR = \frac{1}{2} \times 4k_1 \times 7k_2 = 14k_1 k_2$$

From equation (i),

$$\Delta PQR = 14 \times 20 = 280 \text{ cm}^2$$

Hence, the area of triangle PQR in cm^2 is **280**.

3.20 (A)

Given : $f(x, y) = x^n y^m = P$

Since, x is double and y is half

So,
$$f(x', y') = (2x)^n \times \left(\frac{y}{2}\right)^m$$

$$f(x', y') = 2^n x^n \times y^m \times 2^{-m}$$

$$f(x', y') = 2^{n-m} \times x^n \times y^m$$

Since, $x^n y^m = P$

$$f(x', y') = 2^{n-m} P$$

Hence, the correct option is (A).

3.21 (D)

Given : $ax^2 + bx + c = 0$

The quadratic equation has real and positive roots where a, b and c are real.

So, the roots are :

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For these roots to be real,

$$\sqrt{b^2 - 4ac} > 0 \quad \dots(i)$$

Now, $ax^2 + b|x| + c = 0$

Taking positive sign for x ($x > 0$),

$$ax^2 + bx + c = 0$$

Roots are,

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}, \quad \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

Taking negative sign for x ($x < 0$),

$$ax^2 - bx + c = 0$$

Roots are,

$$x = \frac{+b + \sqrt{b^2 - 4ac}}{2a}, \quad \frac{+b - \sqrt{b^2 - 4ac}}{2a}$$

From equation (i), it is proved that all of these four roots are real.

Hence, the correct option is (D).

Key Point

For roots of a quadratic equation to be positive,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} > 0$$

$$-b \pm \sqrt{b^2 - 4ac} > 0$$

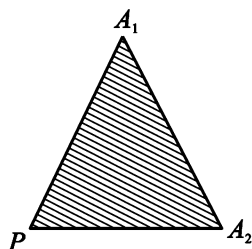
So, $-b + \sqrt{b^2 - 4ac} > 0 \Rightarrow b < \sqrt{b^2 - 4ac}$

$$-b - \sqrt{b^2 - 4ac} > 0 \Rightarrow \sqrt{b^2 - 4ac} < -b$$

Thus, $b < \sqrt{b^2 - 4ac} < -b$

3.22 6

A tetrahedron is a triangular pyramid which has four corners. The internal planes will be made if the point P inside is connected with any two corners out of four (A_1, A_2, A_3, A_4).



Any two corners out of 4 can be selected in ${}^4C_2$ ways. So, new triangular planes,

$${}^4C_2 = \frac{4!}{2!(4-2)!} = \frac{4 \times 3}{2 \times 1} = 6$$

Hence, the correct answer is 6.

3.23 (D)

If x is a real number and

$$|x^2 - 2x + 3| = 11$$

Then, $x^2 - 2x + 3 = -11$

$$x = 4, -2$$

and $x^2 - 2x + 3 = 11$

$$x = \frac{2 \pm j\sqrt{52}}{2}$$

Since, x is real, the possible values of x are,

$$x = 4, -2$$

Now, $y = |-x^3 + x^2 - x|$ (let)

For $x = -2$,

$$y = | -(-2)^3 + (-2)^2 - (-2) |$$

$$y = | 8 + 4 + 2 | = | 14 | = 14$$

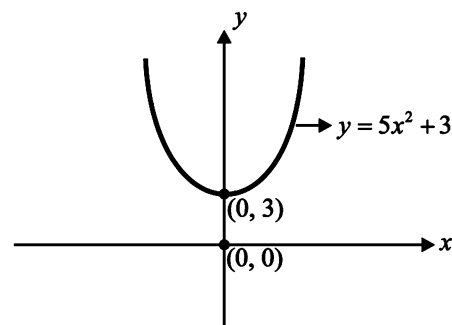
For $x = 4$

$$y = | -(4)^3 + 4^2 - 4 | = | -52 | = 52$$

Hence, the correct option is (D).

3.24 (C)

Given : $y = 5x^2 + 3$



$$\begin{aligned} \text{Slope of tangent} &= \left. \frac{dy}{dx} \right|_{x=0, y=3} = \frac{dy}{dx} = 10x \\ &= \left. \frac{dy}{dx} \right|_{x=0, y=3} = 0 \end{aligned}$$

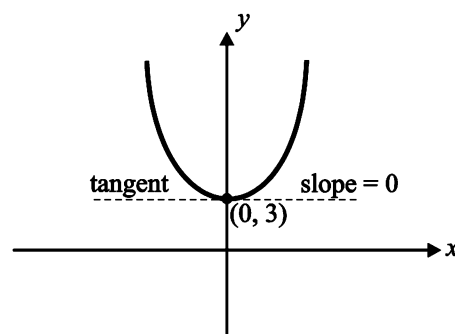
Slope of the tangent is 0.

Equation of tangent is given by,

$$y - y_1 = m(x - x_1)$$

$$y - 3 = 0(x - 0)$$

$$y = 3$$



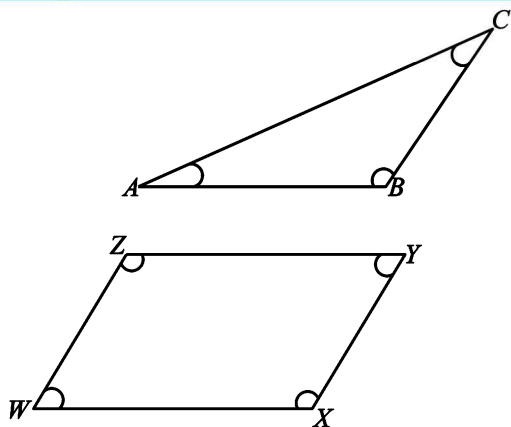
Therefore, the tangent is parallel to the x -axis.

Hence, the correct option is (C).

3.25 180°

Given :

- (i) Smallest angle of triangle is equal to two third of smallest angle of quadrilateral.
- (ii) Ratio between angles of quadrilateral is $3 : 4 : 5 : 6$
- (iii) Largest angle of triangle is twice its smallest angle.



Let us assume

- (i) Largest angle of triangle is $\angle B$ and smallest angle is $\angle C$
- (ii) Largest angle of quadrilateral is $\angle Z$ and smallest is $\angle W$.
- (iii) Angles of quadrilateral are $3K$, $4K$, $5K$ and $6K$.

$$\text{Then, } \angle C = \frac{2}{3} \angle W \quad \dots (i)$$

$$\angle B = 2\angle C \quad \dots (ii)$$

$$\text{Since, } \angle W + \angle X + \angle Y + \angle Z = 360^\circ$$

$$3K + 4K + 5K + 6K = 360^\circ$$

$$K = 20^\circ$$

$$\angle Z = 6K = 6 \times 20^\circ = 120^\circ$$

$$\angle W = 3K = 3 \times 20^\circ = 60^\circ$$

From equation (i) and (ii)

$$\angle C = \frac{2}{3} \times 60^\circ = 40^\circ$$

$$\angle B = 2 \times \angle C = 2 \times 40^\circ = 80^\circ$$

$$\text{Since, } \angle A + \angle B + \angle C = 180^\circ$$

$$\angle A + 80^\circ + 40^\circ = 180^\circ$$

$$\angle A = 60^\circ$$

$$\text{So, } \angle A + \angle Z = 60^\circ + 120^\circ = 180^\circ$$

Hence, sum of the second largest angle of triangle and the largest angle of the quadrilateral is 180° .

3.26 (C)

$$\text{Given : } f(x) = 1 - |x|, \quad -1 \leq x \leq +1$$

Method 1

$$\text{As } |x| = \begin{cases} -x, & x < 0 \\ 0, & x = 0 \\ +x, & x > 0 \end{cases}$$

$$f(x) = 1 - |x| = \begin{cases} 1 + x, & x < 0 \\ 1, & x = 0 \\ 1 - x, & x > 0 \end{cases}$$

For $-1 \leq x \leq +1$,

$$f(x) = \begin{cases} 1 + x, & -1 \leq x < 0 \\ 1, & x = 0 \\ 1 - x, & x > 0 \end{cases}$$

$$f'(x) = \begin{cases} 1, & -1 \leq x < 0 \\ 0, & x = 0 \\ -1, & 0 < x \leq 1 \end{cases}$$

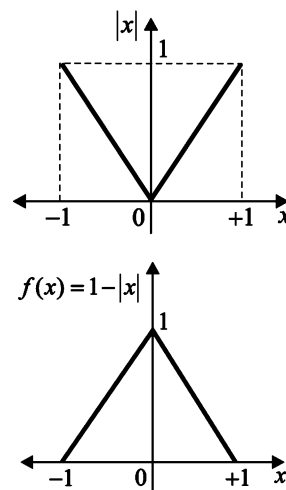
Since, $f'(x) = 0$ at $x = 0$, so $x = 0$ is a stationary point

Therefore,

$$f(x) = 1 - |0| = 1$$

Hence, the correct option is (C).

Method 2



So for maximum value, $f(x) = 1$ at $x = 0$.

Hence, the correct option is (C).

3.27 8

If p, q, r and s are distinct integers then,

$$f(p, q, r, s) = \max(p, q, r, s)$$

$$g(p, q, r, s) = \min(p, q, r, s)$$

$$h(p, q, r, s) = \text{Remainder of}$$

$$\begin{cases} \frac{p \times q}{r \times s}, & \text{if } (p \times q) > (r \times s) \\ \frac{r \times s}{p \times q}, & \text{if } (r \times s) > (p \times q) \end{cases}$$

$$fgh(p, q, r, s) = f(p, q, r, s) \times g(p, q, r, s) \times h(p, q, r, s)$$

To determine,

$$fg(h(2, 5, 7, 3), 4, 6, 8) = ?$$

Firstly calculating $h(2, 5, 7, 3)$

Here, $p = 2, q = 5, r = 7, s = 3$

$$p \times q = 2 \times 5 = 10$$

$$r \times s = 7 \times 3 = 21$$

As $r \times s > p \times q$

$$h(2, 5, 7, 3) = \text{Remainder of } \frac{r \times s}{p \times q}$$

$$h(2, 5, 7, 3) = \text{Remainder} \left(\frac{21}{10} \right)$$

$$h(2, 5, 7, 3) = 1$$

Thus, $fg(h(2, 5, 7, 3), 4, 6, 8) = fg(1, 4, 6, 8)$

$$= f(1, 4, 6, 8) \times g(1, 4, 6, 8)$$

$$= \max(1, 4, 6, 8) \times \min(1, 4, 6, 8)$$

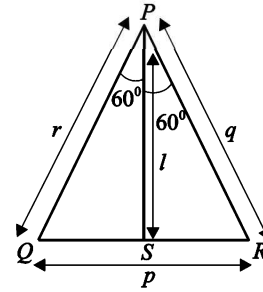
$$= 8 \times 1 = 8$$

Hence, the correct answer is 8.

3.28 (B)

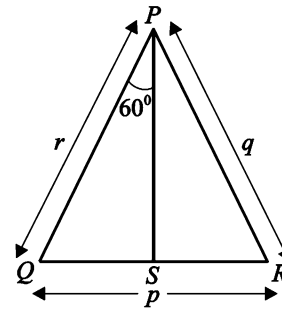
Method 1

Using sine rule, $l = \frac{qr}{q+r}$



Hence, the correct option is (B).

Method 2



Since, $\angle QPR = 120^\circ$. So, it may be an isosceles triangle.

Assuming $\triangle PQR$ to be isosceles.

Thus, $r = q$, $\angle QSP = 90^\circ$

From triangle,

$$\cos 60^\circ = \frac{PS}{PQ} = \frac{PS}{r}$$

$$PS = r \cos 60^\circ = r/2$$

From option (B),

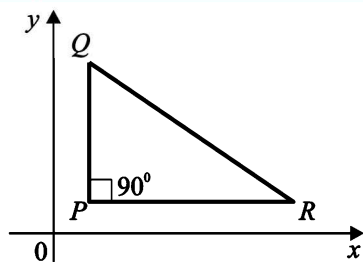
$$\frac{qr}{q+r} = \frac{r^2}{2r} = \frac{r}{2}$$

Hence, the correct option is (B).

3.29 (C)

Given : Total number of points in x -axis according to range $-4 \leq x \leq 5 = 10$.

Total number of points in y -axis according to range $6 \leq y \leq 16 = 11$.



Total number of coordinates that point P can take in given range $= 10 \times 11 = 110$

If P is fixed, then R can only vary in x axis and take total number of co-ordinates $= 9$ and Q can only vary in y axis and take total number of co-ordinates $= 10$.

Therefore, total number of triangle that can be constructed $= 110 \times 9 \times 10 = 9900$

Hence, the correct option is (C).

3.30 (C)

Given :

- (i) $f(x)$ is linear.
- (ii) At $x = -2$, $f(x) = 29$
At $x = 3$, $f(x) = 39$

Let $f(x) = mx + C$,

Then, at $x = -2$,

$$\begin{aligned} f(x) &= m \times -2 + C \\ 29 &= -2m + C \end{aligned} \quad \dots (i)$$

and at $x = 3$,

$$\begin{aligned} f(x) &= m \times 3 + C \\ 39 &= 3m + C \end{aligned} \quad \dots (ii)$$

From equation (i) and (ii),

$$m = 2, C = 33$$

So, at $x = 5$,

$$f(x) = mx + C = 2 \times 5 + 33 = 43$$

Hence, the correct option is (C).

3.31 (B)

Given plot is shown below,

From above figure,

when $y = -1 \Rightarrow x = 2$

From option (A) :

$$\begin{aligned} x &= y - |y| \\ x &= -1 - |-1| = -2 \neq 2 \quad [\text{Incorrect}] \end{aligned}$$

From option (B) :

$$\begin{aligned} x &= -y[y - |y|] \\ x &= -1[-1 - |-1|] = 2 \quad [\text{Correct}] \end{aligned}$$

From option (C) :

$$\begin{aligned} x &= y + |y| \\ x &= -1 + |-1| = 0 \neq 2 \quad [\text{Incorrect}] \end{aligned}$$

From option (D) :

$$\begin{aligned} x &= -[y + |y|] = -[-1 + |-1|] \\ x &= -(-1 + 1) = 0 \neq 2 \quad [\text{Incorrect}] \end{aligned}$$

Hence, the correct option is (B).

3.32 (B)

Given : For a quadratic equation, the product of roots, $\alpha\beta = 4$

$$\frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}} = \frac{\alpha^n + \beta^n}{\frac{1}{\alpha^n} + \frac{1}{\beta^n}} = \frac{\alpha^n + \beta^n}{\frac{\beta^n + \alpha^n}{\alpha^n \beta^n}}$$

$$\alpha^n \times \beta^n = (\alpha\beta)^n = (4)^n$$

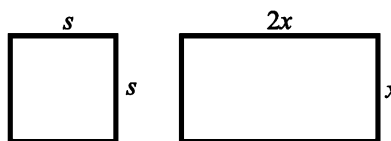
Hence, the correct option is (B).

3.33 (B)

Given : Length of the wire $= 340$ mm

Also the sides of rectangle are in the ratio $1 : 2$.

Method 1



Let length and width of rectangle be $2x$ and x respectively.

$$\text{Perimeter of rectangle} = 2(2x + x) = 6x$$

$$\text{Perimeter of square} = 340 - 6x$$

$$\text{Side of square, } s = \frac{340 - 6x}{4}$$

Total area

$$= \text{Area of square} + \text{Area of rectangle}$$

$$= \left(\frac{340 - 6x}{4} \right)^2 + 2x \times x$$

$$= \left(\frac{340 - 6x}{4} \right)^2 + 2x^2$$

Given condition : Combined area of square + rectangle should be minimum,

$$\text{Let } f(x) = \left(\frac{340 - 6x}{4} \right)^2 + 2x^2$$

For minimum value of $F(x)$

$$f'(x) = 0$$

$$f'(x) = \left[2 \times \left(\frac{340 - 6x}{4} \right) \times \frac{-6}{4} \right] + 4x = 0$$

$$-3 \left(\frac{340 - 6x}{4} \right) = -4x$$

$$\frac{340 - 6x}{4} = \frac{4x}{3}$$

$$\frac{340}{4} = \frac{4x}{3} + \frac{3x}{2}$$

$$\frac{340}{4} = \frac{17x}{6}$$

$$x = \frac{340 \times 6}{17 \times 4} = 30 \text{ mm}$$

Side of square,

$$s = \frac{340 - 6x}{4} = \frac{340 - 180}{4} = 40 \text{ mm}$$

Hence, the correct option is (B).

Method 2

Checking from the options,

Option (A) :

$$\text{Side of the square} = x = 30 \text{ mm}$$

$$\text{Perimeter of the square} = 4 \times 30 = 120 \text{ mm}$$

Therefore,

$$\text{Perimeter of the rectangle} = 340 - 120 = 220 \text{ mm}$$

$$2x + 2 \times 2x = 220$$

$$x = 36.66$$

$$2x = 36.66 \times 2 = 73.32$$

$$\text{Area of square} = x^2 = (30)^2 = 900$$

Area of rectangle

$$= x \times 2x = 36.66 \times 73.32 = 2688.27$$

$$\text{Total area (A)} = 900 + 2688.27 = 3588.27 \text{ mm}^2$$

Option (B) :

$$\text{Side of the square} = x = 40 \text{ mm}$$

$$\text{Perimeter of the square} = 4 \times 40 = 160$$

$$\text{Perimeter of the square} = 340 - 160 = 180 \text{ mm}$$

$$2x + 2 \times 2x = 180 \text{ mm}$$

$$6x = 180 \text{ mm}$$

$$x = 30 \text{ mm}$$

$$\text{Area of the square} = 40 \times 40 = 1600 \text{ mm}^2$$

$$\text{Area of the rectangle} = 30 \times 2 \times 30 = 1800 \text{ mm}^2$$

$$\text{Total area} = 1600 + 1800$$

$$\text{Area (B)} = 3400 \text{ mm}^2$$

Option (C) :

$$\text{Side of the square} = x = 120$$

$$\text{Perimeter of the square} = 4 \times 120 = 480$$

Here perimeter of the square > length of wire

So, this option is incorrect.

Option (D) :

$$\text{Side of the square} = x = 180$$

$$\text{Perimeter of the square} = 4 \times 180 = 720$$

Here perimeter of the square > length of wire

So, this option is incorrect.

On comparing the valid areas of options (A) and (B),

$$\text{Area (B)} < \text{Area (A)}$$

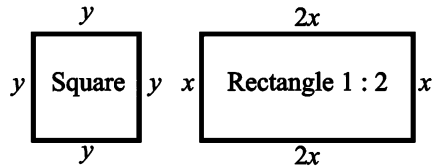
Hence, the correct option is (B).

Method 3

As per data

Wire is divided into two parts –

Let $a + b = 340$



Perimeter of rectangle,

$$b = 2x + x + 2x + x$$

$$b = 6x$$

$$x = b/6$$

and perimeter of square, $a = 4y$

$$y = a/4$$

Sum of area $A = \text{Area of square} + \text{Area of rectangle}$

$$A = y^2 + 2x^2$$

$$A = (a/4)^2 + 2(b/6)^2$$

$$A = \frac{a^2}{16} + \frac{b^2}{18}$$

$$A = \frac{a^2}{16} + \frac{(340-a)^2}{18}$$

For minimum area,

$$\frac{dA}{da} = 0$$

$$\frac{2a}{16} + \frac{2(340-a)}{18} \times (-1) = 0$$

$$\frac{a}{8} = \frac{(340-a)}{9}$$

$$9a = 2720 - 8a$$

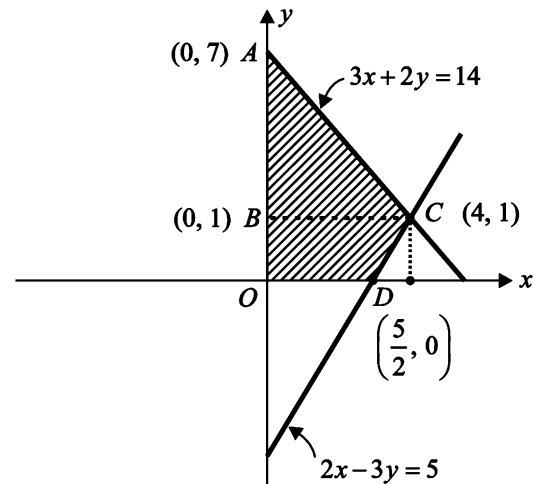
$$a = 160 \text{ m}$$

$$\text{Side of square} = \frac{a}{4} = 40 \text{ m}$$

Hence, the correct option is (B).

3.34 (B)

When we draw lines in first quadrant then we get following diagram.



On solving both equations,

$$3x + 2y = 14 \text{ and } 2x - 3y = 5$$

Point of intersection is, $x = 4, y = 1$

Required area = Area of $\triangle ABC$

+ Area of trapezoid $BCDO$

$$= \frac{1}{2} \times 4 \times 6 + \frac{1}{2} \times (4 + 2.5) \times 1$$

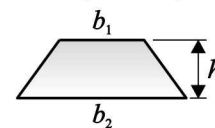
$$(\text{Here, } b_1 = 4, b_2 = 2.5, h = 1)$$

$$= 12 + 3.25 = 15.25 \text{ square units}$$

Hence, the correct option is (B).

Key Point

Area of trapezoid is given by,



$$A = \frac{1}{2} (b_1 + b_2) h$$

3.35 (A)

Given : Interception at x -axis is $\ln x = 0.1$

and slope = -0.02 .

Equation of straight line is given by,

$$y = mx + C$$

According to question,

$$y = m(\ln x) + C$$

where, $m = -0.02$

$$y = -0.02(\ln x) + C \quad \dots(i)$$

Abscissa is known as intercept in x -axis i.e. for $y = 0$, $\ln x = 0.1$

From equation (i),

$$0 = -0.02 \times 0.1 + C$$

$$C = 0.002 \quad \dots(ii)$$

From equations (i) and (ii),

$$y = -0.02(\ln x) + 0.002$$

At $x = 5$,

$$y = -0.02(\ln 5) + 0.002$$

$$y = -0.030$$

Hence, the correct option is (A).

3.36 (C)

At $x = 3$,

From given graph, $f(x)$ must be equals to zero.

From option (A),

$$f(x) = 1 - |x - 1|$$

At $x = 3$,

$$f(3) = 1 - |3 - 1| = 1 - 2 = -1 \neq 0$$

So, it is an incorrect option.

From option (B),

$$f(x) = 1 + |x - 1|$$

At $x = 3$,

$$f(3) = 1 + |3 - 1| = 1 + 2 = 3$$

So, it is an incorrect option.

From option (C),

$$f(x) = 2 - |x - 1|$$

$$\text{At } x = 3, f(3) = 2 - |3 - 1| = 2 - 2 = 0$$

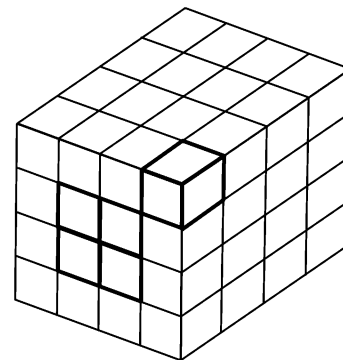
It is the correct option.

Hence, the correct option is (C).

3.37 (D)

Given :

- (i) Total number of cubes = 64
- (ii) Total number of cubes that are removed from each corner = 08



Method 1

Area of first face of cube after removal,

$$= 12 \times 1 = 12 \text{ m}^2 \quad [\text{Existing surface}]$$

For six faces, area = $12 \times 6 = 72 \text{ m}^2$

After removing 8 cubes, visible surface area at each corner = $03 \times 8 \times 1 = 24 \text{ m}^2$

Total surface area = $72 + 24 = 96 \text{ m}^2$

Hence, the correct option is (D).

Method 2

Removed cube will leave same area as they covered before so still area will remain same

Area of one surface = 16 unit^2

and total number of surfaces = 6

Total surface area = $16 \times 6 = 96 \text{ unit}^2$

Hence, the correct option is (D).

3.38 (B)

Given : $f(x) = 2x^7 + 3x - 5$

From option (A) :

$$x^3 + 8 = 0$$

$$x^3 = -8$$

$$x = -2$$

For $x = -2$,

$$f(x) = 2x^7 + 3x - 5$$

$$f(-2) = 2(-2)^7 + 3(-2) - 5$$

$$f(-2) = -256 - 6 - 5 = -267$$

So, this is not a factor of $f(x)$

From option (B) :

$$x - 1 = 0$$

$$x = 1$$

For $x = 1$,

$$f(x) = 2x^7 + 3x - 5$$

$$f(1) = 2(1)^7 + 3(1) - 5 = 5 - 5 = 0$$

So, $(x-1)$ is a factor of $f(x)$.

Hence, the correct option is (B).

3.39 (B)

Since, the number of cycles to failure decreases exponentially with an increase in load. The general equation is given by,

$$y = ne^{-mx}$$

where, y = number of cycle failure and x is load

Given : $y = 100$ and $x = 80$

$$\text{Therefore, } 100 = ne^{-80m} \quad \dots(i)$$

When load is halved, it take 10000 cycle for failure.

$$10000 = ne^{-40m} \quad \dots(ii)$$

From equation (i) and (ii)

$$100 = e^{40m}$$

$$m = \frac{\ln 100}{40} \quad \dots(iii)$$

For 5000 cycles to failure,

$$5000 = ne^{-xm} \quad \dots(iv)$$

From equation (ii) and (iv),

$$2 = e^{m(x-40)}$$

$$m(x-40) = \ln 2$$

From equation (iii),

$$x - 40 = \frac{\ln 2}{m}$$

$$x - 40 = \frac{\ln 2}{\ln 100} \times 40$$

$$x - 40 = \frac{0.693}{4.605} \times 40$$

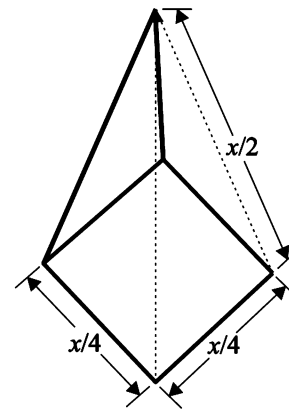
$$x = 46.02$$

Hence, the correct option is (B).

3.40 (D)

Base perimeter of square pyramid = $x = p$

$$\text{Slant height} = \frac{x}{2} = l$$



Lateral surface area of pyramid

$$= \frac{1}{2} \times \text{Base perimeter } (p) \times \text{slant height } (l)$$

$$A = \frac{1}{2} \times p \times l$$

$$A = \frac{1}{2} \times x \times \frac{x}{2}$$

$$A = \frac{x^2}{4}$$

$$A = 0.25x^2$$

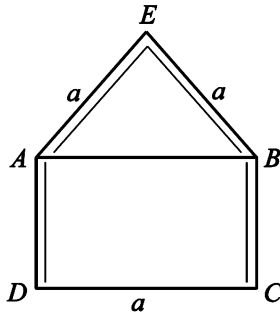
Hence, the correct option is (D).

3.41 (B)

Given : Perimeter of the window = 6 m,

$$5a = 6 \text{ m}$$

$$a = \frac{6}{5} \text{ m}$$



Area of window will be,

A = area of triangle ABE + area of rectangle $ABCD$

$$A = \frac{\sqrt{3}}{4} \times a^2 + a^2$$

$$A = \left(\frac{\sqrt{3}}{4} + 1 \right) a^2 = \left(\frac{\sqrt{3}}{4} + 1 \right) \times \frac{36}{25} = 2.06$$

Hence, the correct option is (B).

3.42 (A)

Given : $a \square b = ab + (a + b)$... (i)

and $a \square x = a$

Checking from options,

From option (A) : $x = 0$

From equation (i),

$$a \square 0 = a$$

$$a \square b = ab + (a + b)$$

For $b = 0$,

$$a \square 0 = a \times 0 + (a + 0) = a$$

Option (A) satisfied the property of identify element.

Hence, the correct option is (A).

3.43 (C)

Given : $y = \ln \left\{ e^{\left| \sin(|x|) \right|} \right\}; |x| < 2\pi$

where, x represents the abscissa and y represents the ordinate.

At $x = 2\pi$,

$$y = \ln \left\{ e^{\left| \sin 2\pi \right|} \right\} = 0$$

So, option (D) is incorrect.

$$\text{At } x = \frac{3\pi}{2},$$

$$y = \ln \left\{ e^{\left| \sin \frac{3\pi}{2} \right|} \right\} = 0$$

$$y = \ln e = 1$$

This eliminates option (A) and (B) as well.

Hence, the correct option is (C).

3.44 (B)

$$\text{Let, } f(x) = \frac{(x+y) - |x-y|}{2} \quad \dots (i)$$

$|x-y|$ can be in one of the two following forms

$$\begin{array}{c} |x-y| \\ \swarrow \quad \searrow \\ +(x-y) = x-y \quad -(x-y) = -x+y \end{array}$$

Taking $|x-y| = +(x-y)$

From equation (i),

$$f(x) = \frac{(x+y) - |x-y|}{2}$$

$$f(x) = \frac{x+y-x+y}{2} = \frac{2y}{2} = y$$

$(x > y)$ y is minimum

Taking $|x-y| = -(x-y)$

From equation (i),

$$f(x) = \frac{(x+y) - [-(x-y)]}{2}$$

$$f(x) = \frac{x+y+x-y}{2} = x$$

$(x < y)$ x is minimum

Thus, from both cases, function $f(x)$ is equal to minimum of x and y .

Hence, the correct option is (B).

3.45 (C)

$$f(x) = e^x + 0.5x^2 - 2$$

At $x = 0$,

$$f(0) = e^0 + 0 - 2 = 1 - 2$$

$$f(0) = -1$$

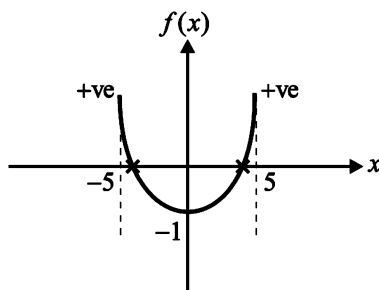
At $x = -5$,

$$f(-5) = 10.5 \quad (+ve)$$

At $x = 5$,

$$f(5) = 158.91 \quad (+ve)$$

Based on these assertions, the approximate graph of $f(x)$ can be drawn as below :



From the above graph, it is clear that $f(x) = 0$ is having two roots in the range of $[-5, 5]$.

Hence, the correct option is (C).

3.46 (D)

Given :

- (i) Series is 1, x , x , x , y , y , 9, 16, 18.
- (ii) Mean and median are equal.
- (iii) Mean and median are equal to twice the mode.

$$\text{Mean} = \frac{1 + x + x + x + y + y + 9 + 16 + 18}{9}$$

$$M = \frac{3x + 2y + 44}{9}$$

Median is defined as the number at the centre of the series.

Hence, Median = y

Mode is defined as the number which is most repeated in the series.

$$\text{Mode} = x$$

Now, Mean = median = $2 \times$ Mode

$$\frac{3x + 2y + 44}{9} = y = 2x$$

$$(i) \quad \frac{3x + 2y + 44}{9} = 2x$$

$$15x - 2y = 44 \quad \dots (i)$$

$$(ii) \quad \frac{3x + 2y + 44}{9} = y$$

$$-3x + 7y = 44 \quad \dots (ii)$$

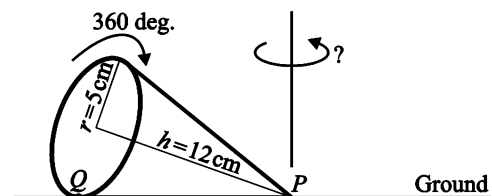
From equation (i) and (ii),

$$y = 8, x = 4$$

Hence, the correct option is (D).

3.47 (D)

Given :

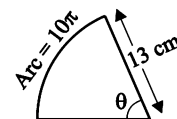


Distance travelled by cone in one rotation while P is fixed until the Q touches the ground again, is given by,

$$\text{Perimeter} = 2\pi r = 2\pi \times 5 = 10\pi$$

Slant height of the cone is given by,

$$S = \sqrt{5^2 + 12^2} = 13$$



$$\text{Arc} = 10\pi \text{ cm}$$

Angle about P is given by,

$$\theta = \frac{\text{arc}}{\text{Slant height}} = \frac{10\pi}{13} \text{ rad}$$

Hence, the correct option is (D).

3.48 (B)

Given :

Employees	Salaries
45	20,000
25	30,000
20	40,000
8	60,000
2	150,000

Median is defined as the data in the series which is in middle of the series.

According to the table, the employee that is in the middle is one of the 25 employees, whose salary is 30,000.

So, median of the salaries is 30,000.

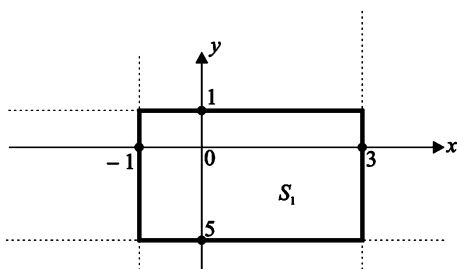
Hence, the correct option is (B).

3.49 (C)

Given :

(i) Plane $S_1 : |x-1| \leq 2$ and $|y+2| \leq 3$

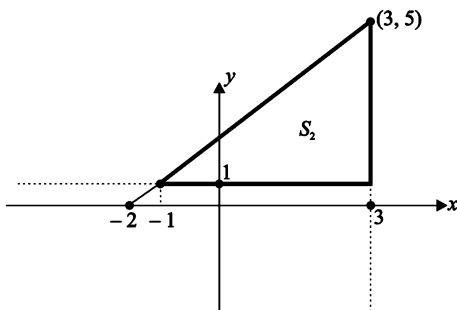
$$\text{or } \begin{matrix} x-1=2 & & y+2=3 \\ x-1=-2 & \text{and} & y+2=-3 \end{matrix}$$



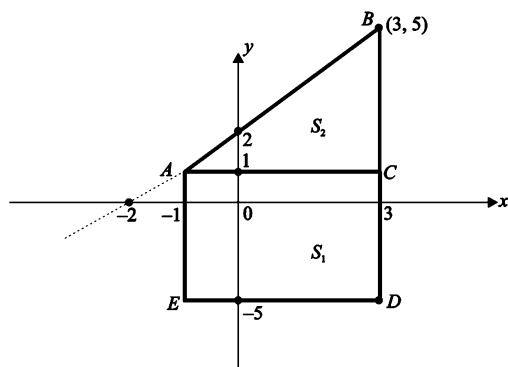
(ii) Plane $S_2 : x-y \geq -2$, $y \geq 1$ and $x \leq 3$

$$\text{or } x-y=-2, y=1 \text{ and } x=3$$

$$\Rightarrow y = x+2$$



Union of S_1 and S_2 i.e. S is shown below,



$$\text{Area of } ACDE = 6 \times 4 = 24$$

$$\text{Area of } ABC = \frac{1}{2} \times 4 \times 4 = 8$$

$$\text{Total area} = 24 + 8 = 32$$

Hence, the correct option is (C).

3.50 (A)

$$\text{Given : } F(a, b) = (a-b)^2, G(a, b) = |a-b|$$

$$\text{So, } F(1, 3) = (1-3)^2 = 4$$

$$G(1, 3) = |1-3| = 2$$

$$G[F(1, 3), G(1, 3)] = G(4, 2) = |4-2|$$

$$G[F(1, 3), G(1, 3)] = 2$$

Hence, the correct option is (A).

3.51 (D)

$$\text{Given : } f(x) = 0 \text{ for } x = (-2, 0, 3)$$

$$f(x) = (x+2)x(x-3) = 0$$

Putting $x \rightarrow (x-3)$ in above equation,

$$f(x-3) = (x-3+2)(x-3)(x-3-3) = 0$$

$$x = 1, 3, 6$$

Hence, the correct option is (D).

3.52 (C)

Given :

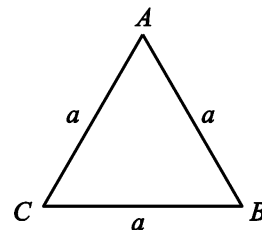
The area of an equilateral triangle $= \sqrt{3}$.

The area of an equivalent triangle ABC of side length a is given by,

$$\text{Area } A = \frac{\sqrt{3}}{4} a^2$$

$$\sqrt{3} = \frac{\sqrt{3}}{4} a^2$$

$$a = \pm 2$$



Since, length can never be negative.

$$\text{So, } a = 2$$

The perimeter of the triangle is given by,

$$\text{Perimeter} = 3a = 3 \times 2 = 6$$

Hence, the correct option is (C).

3.53 (D)

- (i) A cuboid with dimensions 10 cm, 8 cm and 6 cm.

The volume of cuboid is given by,

$$V_{\text{cuboid}} = lbh = 10 \times 8 \times 6 = 480 \text{ cm}^3$$

...(i)

- (ii) A cube of side 8 cm.

The volume of cube is given by,

$$V_{\text{cube}} = a^3$$

where, a is the side length.

$$V_{\text{cube}} = 8^3 = 512 \text{ cm}^3 \quad \dots(\text{ii})$$

- (iii) Cylinder with base radius 7 cm and height 7 cm.

The volume of cylinder is given by,

$$V_{\text{cylinder}} = \pi r^2 h$$

$$V_{\text{cylinder}} = \pi \times 7^2 \times 7 = 1077.566 \quad \dots(\text{iii})$$

- (iv) Sphere of radius 7 cm.

The volume of sphere is given by,

$$V_{\text{sphere}} = \frac{4\pi}{3} \times r^3 \quad \text{where, } r = \text{Radius}$$

$$V_{\text{sphere}} = \frac{4\pi}{3} \times 7^3 = 1436.753 \quad \dots(\text{iv})$$

From equations (i), (ii), (iii) and (iv),

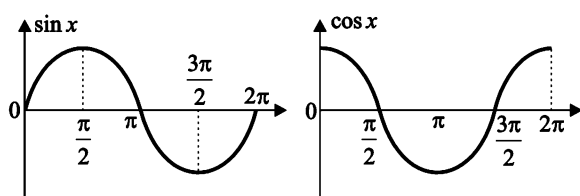
Descending order of the volume is given by,

$$(\text{iv}) > (\text{iii}) > (\text{ii}) > (\text{i})$$

Hence, the correct option is (D).

3.54 (B)

The waveform $\sin x$ and $\cos x$ over the interval $0 \leq x \leq 2\pi$ is given by,



S. No.	Function	Status	Interval
1.	$\sin x$	Increasing	$0 < x < \frac{\pi}{2}$
		Increasing	$\frac{3\pi}{2} < x < 2\pi$
		Decreasing	$\frac{\pi}{2} < x < \frac{3\pi}{2}$
2.	$\cos x$	Decreasing	$0 < x < \pi$
		Increasing	$\pi < x < 2\pi$

For the interval $\left(\frac{\pi}{2}, \pi\right)$, $\sin x$ and $\cos x$ both are decreasing function.

Hence, the correct option is (B).

3.55 (C)

Given : $x^2 + x - 1 = 0$

$$x^2 = 1 - x$$

Dividing x on both side,

$$x = \frac{1}{x} - 1$$

$$x - \frac{1}{x} = -1 \quad \dots(\text{i})$$

Expansion of $\left(x^2 + \frac{1}{x^2}\right)^2$ is given by,

$$\left(x^2 + \frac{1}{x^2}\right)^2 = x^4 + \frac{1}{x^4} + 2$$

$$x^4 + \frac{1}{x^4} = \left(x^2 + \frac{1}{x^2}\right)^2 - 2$$

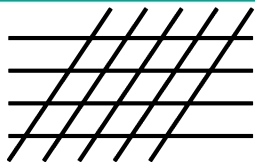
$$x^4 + \frac{1}{x^4} = \left\{\left(x - \frac{1}{x}\right)^2 + 2\right\}^2 - 2$$

$$x^4 + \frac{1}{x^4} = \{(-1)^2 + 2\}^2 - 2 = 9 - 2 = 7$$

Hence, the correct option is (C).

3.56 (C)

Given : A set of 4 parallel lines intersects with another set of 5 parallel lines.



From above figure, it is clear that to form a parallelogram, two horizontal lines and two vertical lines are required.

Therefore, the number of parallelograms formed is given by,

$$n = {}^5C_2 \times {}^4C_2 = 10 \times 6 = 60$$

Hence, the correct option is (C).

3.57 (D)

Given :

- (i) Hema = $2 \times \text{Hari} + 5$
- (ii) Suresh = $10 \times \text{Hari} - 13$
- (iii) Suresh = $3 \times \text{Hema}$
 $\text{Suresh} = 10 \times \text{Hari} - 13 = 3 \times \text{Hema}$
 $\text{Hari} = \frac{3 \times \text{Hema} + 13}{10} \quad \dots (i)$
 $\text{Hema} = 2 \times \text{Hari} + 5 \quad \dots (ii)$

From equation (i) and (ii),

$$\text{Hema} = 2 \left[\frac{3 \times \text{Hema} + 13}{10} \right] + 5$$

$$\text{Hema} \left[1 - \frac{6}{10} \right] = \frac{26}{10} + 5$$

$$\text{Hema} \times \frac{4}{10} = \frac{76}{10} \Rightarrow \text{Hema} = 19$$

Hence, the correct option is (D).

3.58 (B)

Given : Graph is shown below,

- (i) $y = 2x + 4$ for $-3 \leq x \leq -1$
 At $x = -3$, $y = -2$ (Accurate)
 At $x = -2$, $y = 0$ (Accurate)
 At $x = -1$, $y = 2$ (Accurate)
- (ii) $y = |x - 1|$ for $-1 \leq x \leq 2$
 At $x = -1$, $y = 2$ (Accurate)
 At $x = 0$, $y = 1$ (Accurate)

At $x = 1$, $y = 0$ (Accurate)

At $x = 2$, $y = 1$ (Accurate)

(iii) $y = ||x| - 1|$ for $-1 \leq x \leq 2$

At $x = -1$, $y = ||-1| - 1| = 0$ [Inaccurate]

(iv) $y = 1$ for $-1 \leq x \leq 2$ [Accurate]

Hence, the correct option is (B).

3.59 (B)

Given : $\frac{\log P}{y-z} = \frac{\log Q}{z-x} = \frac{\log R}{x-y} = 10$

From the above equation,

$$\log P = 10(y-z)$$

$$\log Q = 10(z-x)$$

$$\log R = 10(x-y)$$

$$\log P + \log Q + \log R = 10[(y-z) + (z-x) + (x-y)]$$

$$\log P + \log Q + \log R = 0$$

$$\log(PQR) = \log 1$$

Value of the product $PQR = 1$

Hence, the correct option is (B).

3.60 (C)

Given :

- (i) For loss, $L_1 = 4900$, deviation $D_1 = 7$
- (ii) For loss, $L_2 = ?$, deviation $D_2 = 4$
- (iii) Loss is proportional to the square of deviation of target i.e.

$$L \propto D^2$$

So, $\frac{L_1}{L_2} = \frac{D_1^2}{D_2^2}$

$$\frac{4900}{L_2} = \frac{(7)^2}{(4)^2}$$

$$L_2 = 1600$$

Hence, the correct option is (C).

3.61 (B)

From the given graph,

x	y
0	0
± 1	-1
± 2	0

Checking from options :

At $x = 1$,

Option (A) :

$$y = ||x| + 1| - 2 = 2 - 2 = 0$$

According to the table shown above, option (A) is incorrect.

Option (B) :

$$y = ||x| - 1| - 1 = 0 - 1 = -1$$

According to the table shown above, option (B) is correct.

Option (C) :

$$y = ||x| + 1| - 1 = 2 - 1 = 1$$

According to the table shown above, option (C) is incorrect.

Option (D) :

$$y = ||x - 1| - 1| = |0 - 1| = 1$$

According to the table shown above, option (D) is incorrect.

Hence, the correct option is (B).

3.62 (B)

Let the length and breadth of rectangle are L and B . So,

$$\text{Area } (A_R) = L \times B$$

By reducing length by 10 m and breadth by 5 m, rectangle becomes square (arms of a square are equal).

$$\text{So, } L - 10 = B - 5$$

$$L - B = 5 \quad \dots(i)$$

$$\text{Area of square} = A_R - 650$$

$$(L - 10)(B - 5) = A_R - 650$$

$$LB - 5L - 10B + 50 = A_R - 650$$

$$5L + 10B = 700 \quad \dots(ii)$$

From equation (i) and (ii),

$$B = 45 \text{ m, } L = 50 \text{ m}$$

Area of rectangle,

$$A_R = 45 \times 50 = 2250 \text{ m}^2$$

Hence, the correct option is (B).

3.63 (A)

Given :

$$\log|a| + \log|b| + \log|c| = 0 \quad \dots(i)$$

$$\log[|a||b||c|] = 0$$

$$|a| \times |b| \times |c| = 1$$

Let, $a = 1$

$$|b| \times |c| = 1$$

$$|b| = \frac{1}{|c|}$$

Now, equation (i) will be satisfied for multiple values of b and c [$a = 1$]

Therefore, checking from the options,

From option (A),

$$\text{Maximum value} = 3$$

$$\text{Minimum value} = -3$$

Now, equation (i) will be true, only if $|a|$, $|b|$ and $|c|$ all are equal to 1.

$$\text{So, maximum value} = a + b + c|_{\max}$$

$$= 1 + 1 + 1 = 3$$

$$\text{and minimum value} = a + b + c|_{\min}$$

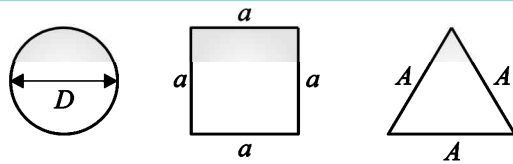
$$= -1 - 1 - 1 = -3$$

Hence, the correct option is (A).

3.64 (A)

Given : Parameters of circle, square and equilateral triangle are equal.

$$\text{So, } \pi D = 4a = 3A \quad \dots(i)$$



$$\text{Area of circle} = \frac{\pi}{4} D^2 \quad \dots(\text{ii})$$

$$\text{Area of square} = a^2$$

From equation (i),

$$a^2 = \left(\frac{\pi D}{4} \right)^2 = \frac{\pi^2 D^2}{16} \quad \dots(\text{iii})$$

$$\text{Area of equilateral triangle} = \frac{\sqrt{3}}{4} A^2$$

From equation (i),

$$\frac{\sqrt{3}}{4} A^2 = \frac{\sqrt{3}}{4} \left(\frac{\pi D}{3} \right)^2 = \frac{\sqrt{3} \pi^2 D^2}{36} \quad \dots(\text{iv})$$

From equation (ii), (iii) & (iv),

$$\frac{\pi D^2}{4} > \frac{\pi^2 D^2}{16} > \frac{\sqrt{3} \pi^2 D^2}{36}$$

Therefore, area of the circle is largest.

Hence, the correct option is (A).

3.65 (C)

$$\text{Let } I = \frac{1}{1 + \log_u vw} + \frac{1}{1 + \log_v wu} + \frac{1}{1 + \log_w uv}$$

$$I = \frac{1}{1 + \frac{\log_e vw}{\log_e u}} + \frac{1}{1 + \frac{\log_e wu}{\log_e v}} + \frac{1}{1 + \frac{\log_e uv}{\log_e w}}$$

$$\left\{ \log_a b = \frac{\log_e b}{\log_e a} \right\}$$

$$I = \frac{\log u}{\log u + \log v + \log w} + \frac{\log v}{\log u + \log v + \log w} + \frac{\log w}{\log u + \log v + \log w}$$

$$I = \frac{\log u + \log v + \log w}{\log u + \log v + \log w} = 1$$

Hence, the correct option is (C).

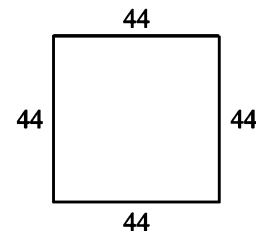
3.66 (C)

Area of wire, when it is bent into square

$$= 1936 \text{ m}^2$$

$$A^2 = 1936 \text{ m}^2$$

$$A = 44 \text{ m}$$



So, the length of wire $= 4A = 4 \times 44 = 176 \text{ m}$

Wire is divided into two pieces, longer piece is thrice as long as shorter piece.

So, longer piece length $= 3 \times 44 = 132 \text{ m}$

And shorter piece length $= 1 \times 44 = 44 \text{ m}$

According to question,

Longer piece wire is bent into square,

$$\text{So, } 4A = 132$$

$$A = 33 \text{ m}$$

Therefore, area of longer piece wire's square,

$$= A^2 = 33^2 = 1089 \text{ m}^2$$

Shorter piece wire is bent in circle,

So, circle perimeter $= \pi D = 44$

$$\frac{22}{7} \times D = 44$$

$$D = 14 \text{ m}$$

$$\text{Area of circle} = \frac{\pi}{4} \times D^2 = \frac{\pi}{4} \times 14^2 = 153.94 \text{ m}^2$$

Total area enclosed

$$= \text{Area of square} + \text{Area of circle}$$

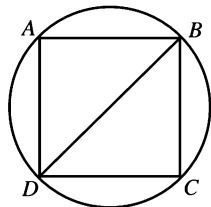
$$= 1089 + 153.94$$

$$= 1242.97 \approx 1243 \text{ m}^2$$

Hence, the correct option is (C).

3.67 (D)

Given :

Area of the Square $ABCD = (\text{side})^2 = d$ i.e. side $= \sqrt{d}$

$$\text{Circumradius} = \frac{\text{Diagonal}}{2} = \sqrt{\frac{d}{2}}$$

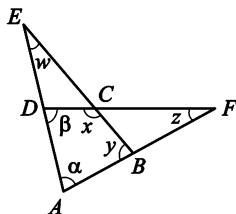
$$\text{Area of a Circle} = \pi \times \left(\frac{\text{diameter}}{2} \right)^2$$

$$\text{Area of a Circle} = \pi \times \sqrt{\frac{d}{2}} \times \sqrt{\frac{d}{2}} = \frac{1}{2} \pi d$$

Hence, the correct option is (D).

3.68 (A)

Given :



$$\angle w + \angle z = ?$$

In $\triangle ABE$,

$$\angle \alpha + \angle \gamma + \angle w = 180^\circ \quad \dots(i)$$

In $\triangle ADF$,

$$\angle \alpha + \angle \beta + \angle z = 180^\circ \quad \dots(ii)$$

In $\square ABCD$,

$$\angle \alpha + \angle \beta + \angle x + \angle y = 360^\circ \quad \dots(iii)$$

Here, sum of equation (i) and (ii) is equivalent to equation (iii)

$$2\angle \alpha + \angle \gamma + \angle w + \angle \beta + \angle z = \angle \alpha + \angle \beta + \angle x + \angle y$$

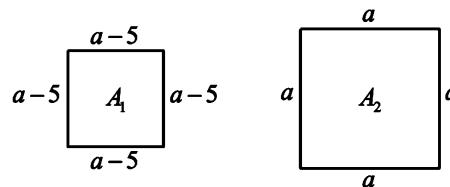
$$\angle w + \angle z = \angle x - \angle \alpha$$

$$\angle DEC + \angle BFC = \angle BCD - \angle BAD$$

Hence, the correct option is (A).

3.69 (D)

Given :



$$\text{and } A_2 = 4A_1 \quad \dots(i)$$

$$\text{Area of } A_1 = (a-5)^2, \text{ Area of } A_2 = a^2$$

From equation (i),

$$a^2 = 4(a-5)^2$$

$$a^2 = 4a^2 + 100 - 40a$$

$$3a^2 - 40a + 100 = 0$$

$$a = 10, 3.33$$

Since, a can not be less than 5, So $a = 3.33$ is incorrect.

Hence, the correct option is (D).

3.70 (D)

Given :

$$(i) \quad \text{Dimension of wall} = 30\text{m} \times 12\text{m} \times 6\text{m}$$

$$\text{Volume} = 2160 \text{ m}^3$$

$$(ii) \quad \text{Dimension of brick} = 8 \text{ cm} \times 6 \text{ cm} \times 6 \text{ cm}$$

$$\text{Volume of brick} = 288 \text{ cm}^3 = 288 \times 10^{-6} \text{ m}^3$$

$$(iii) \quad 60\% \text{ of the wall consists of bricks.}$$

$$\text{So, } 2160 \times \frac{60}{100} = 1296 \text{ m}^3$$

Number of bricks used for construction is given by,

$$N = \frac{1296}{288 \times 10^{-6}} = 45 \times 10^5 = 45 \text{ lakhs}$$

Hence, the correct option is (D).

3.71 (C)

Let the cost of the gift be x .

Since, two of them are not contributing, each friend will pay 150 more. So,

$$x = \frac{8x}{10} + 8 \times 150$$

$$\frac{2x}{10} = 1200$$

$$x = 6000$$

Hence, the correct option is (C).

3.72 (A)

Given :

(i) $XYZ = 192$

(ii) $Z = 4$

(iii) $P = \frac{X+Y}{2}$

192 can be factorized as,

$$192 = 2^6 \times 3$$

Since, $Z = 4$

$$192 = (Z = 4) \times 2^4 \times (2 \times 3)$$

or $192 = (Z = 4) \times 2 \times 24$

or $192 = (Z = 4) \times 3 \times 16$

or $192 = (Z = 4) \times 4 \times 12$

or $192 = (Z = 4) \times 6 \times 8$

For above mentioned all the cases, only (8, 6) is the combination for which P will be minimum.

$$P = \frac{8+6}{2} = 7$$

Hence, the correct option is (A).

3.73 (A)

Given :

(i) Area of mansion = $70 \times 55 = 3850 \text{ m}^2$

(ii) Area for flower plot = 550 m^2

(iii) Area for carpet = $3850 - 550 = 3300 \text{ m}^2$

So, total money spent on carpet

$$= 3300 \times 50 = \text{Rs.}165000$$

Hence, the correct option is (A).

3.74 (A)

Given : $x + y = 26$

...(i)

$$x \times y = 165$$

$$y = \frac{165}{x}$$

Putting the value of y in equation (i),

$$x + \frac{165}{x} = 26$$

$$x^2 + 165 = 26x$$

$$x^2 - 26x + 165 = 0$$

$$x^2 - 15x - 11x + 165 = 0$$

$$x = 15, 11$$

Taking $x = 15$,

$$y = \frac{165}{15} = 11$$

Taking $x = 11$,

$$y = \frac{165}{11} = 15$$

So, the difference between x and y is 4.

Hence, the correct option is (A).

3.75 (A)

Given : a, b, c are real numbers

$$ax^2 - bx + c = 0 \quad \dots (i)$$

Given, equation (i) has equal roots, which is β

Now, product of the roots will be

$$\beta \cdot \beta = \frac{c}{a}$$

$$\beta^2 = \frac{c}{a} \quad \dots (ii)$$

And sum of the roots will be

$$\beta + \beta = \frac{b}{a}$$

$$2\beta = \frac{b}{a}$$

$$\beta = \frac{b}{2a} \quad \dots (iii)$$

Multiplying equation (ii) and (iii),

$$\beta^3 = \frac{bc}{2a^2}$$

Hence, the correct option is (A).

3.76 (B)**Given :** $f(x_1 + x_2) \geq f(x_1) + f(x_2)$ $x > 1$ Consider, $x_1 = 2$ and $x_2 = 3$

Checking from options we have

For option (A),

$$\sqrt{2+3} \geq \sqrt{2} + \sqrt{3}$$

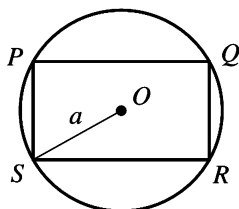
$$2.236 \geq 3.146$$

For option (B),

$$e^{2+3} \geq e^2 + e^3$$

$$148.41 \geq 27.47 \text{ it holds the inequality}$$

Hence, the correct option is (B).

3.77 (D)

Area of shaded region = Area of circle – Area of square

$$\text{Area of circle} = \pi a^2$$

$$\text{Area of square} = (\text{side})^2$$

$$\text{Side of square} = \sqrt{2}a$$

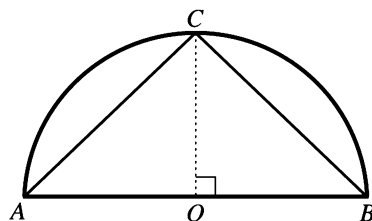
$$\text{Area of square} = \sqrt{2}a \times \sqrt{2}a = 2a^2$$

$$\text{Area of shaded region} = \pi a^2 - 2a^2$$

Hence, the correct option is (D).

3.78 (D)

Given figure is as shown below,



Let 'r' be the radius of the semicircle

$$\Rightarrow \overline{AO} = \overline{OB} = \overline{OC} = r$$

Using pythagores theorem

$$\overline{AC}^2 = \overline{AO}^2 + \overline{OC}^2$$

$$\Rightarrow \overline{AC}^2 = r^2 + r^2 = 2r^2$$

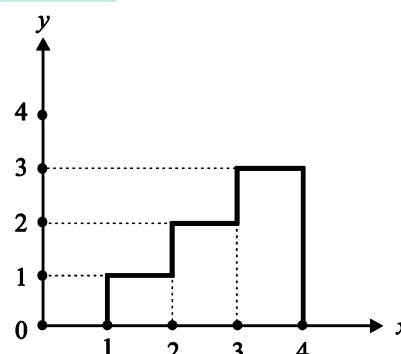
$$\Rightarrow \overline{AC} = \sqrt{2}r$$

Similarly, $\overline{BC} = \sqrt{2}r$

$$\therefore \frac{\overline{AC} + \overline{CB}}{\overline{AB}} = \frac{\sqrt{2}r + \sqrt{2}r}{2r}$$

$$\Rightarrow \frac{\overline{AC} + \overline{CB}}{\overline{AB}} = \sqrt{2} = 1.414$$

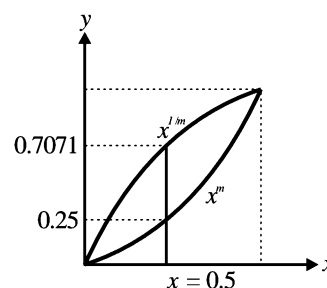
Hence, the correct option is (D)

3.79 (C)Area under $y = [x]$ is

$$= 1 \times (2-1) + 2 \times (3-2) + 3 \times (4-3)$$

$$= 1 + 2 + 3 = 6$$

Hence, the correct option is (C)

3.80 (B)**Given :** $\left. \begin{array}{l} y = x^m \\ y = x^{1/m} \end{array} \right\} 0 \leq x \leq 1$ Put $x = 0.5$ and $m = 2$,

$$y = x^m = 0.5^2 = 0.25$$

$$y = x^{1/m} = 0.5^{1/2} = 0.7071$$

Hence, the correct option is (B)

3.81 (C)

Let x and y be the two numbers

Given $x + y = 100$ and $(x - 5)(y - 5) = 0$

Solving above equations, we get

$$x = 5, y = 95$$

Hence, the correct option is (C).

3.82 (C)

The unit place of 23591749^{110016} depends on the units place digit of 26591749 and 110016. Here, the unit's digit is 9 and has an even power. For any even power of 9, the unit digit is 1.

$\therefore$ The unit's digit of 26591749^{110016} is 1.

Hence, the correct option is (C)

3.83 (A)

Given : $f(x) = x^2$ for each $x \in (-\infty, \infty)$

$$f(f(f(x))) = f(f(x^2)) = f((x^2)^2)$$

$$f(f(f(x))) = f(x^4) = (x^4)^2 = x^8$$

$$\frac{f(f(f(x)))}{f(x)} = \frac{x^8}{x^2} = x^6 = (f(x))^3$$

Hence, the correct option is (A).

3.84 (D)**Method 1**

Non-leap year repeats after 6 or 11 years

Note : Above statement is valid only if leap year is repeated every 4 years.

$$2013 + 6 = 2019$$

So, 2013 and 2019 has same calendar.

Hence, the correct option is (D).

Method 2

Year	Odd days
2013	1
2014	1
2015	1
2016	2
2017	1
2018	1

} Odd days = 7

So, 2013 and 2019 has same calendar.

Hence, the correct option is (D).

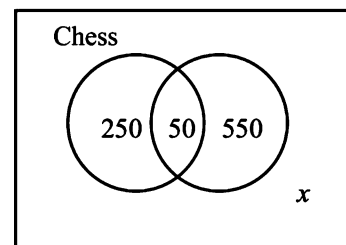
3.85 (B)

Given : Total numbers of student = 1000

Number of students play chess = 300

Number of students play football = 600

Let x = number of students play neither chess nor foot ball



From Venn diagram,

$$250 + 50 + 550 + x = 1000$$

$$x = 150 \text{ students}$$

Hence, the correct option is (B).

3.86 (C)

Odd series : 1, 3, 5...99

$$99 = 1 + (n - 1)2$$

$$n = 50$$

$$S_{\text{odd}} = \left(\frac{1 + 99}{2} \right) \times 50 = 2500$$

Even series : 150, 152, 154,...200

$$200 = 150 + (n - 1)2$$

$$n = 26$$

$$S_{\text{even}} = \left(\frac{150 + 200}{2} \right) \times 26 = 4550$$

Therefore, the ratio is given by,

$$\frac{S_{\text{odd}}}{S_{\text{even}}} = \frac{2500}{4550} = \frac{50}{91}$$

Hence, the correct option is (C).

3.87 (C)

Surface area of the ring = $\pi b^2 - \pi a^2$

Radius of painted circle on the ring = $\frac{b-a}{2}$

Area of each painted circle = $\frac{\pi}{4}(b-a)^2$

∴ Area of n circles that can be painted

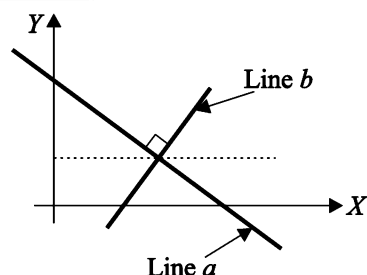
$$= \frac{n\pi}{4}(b-a)^2$$

∴ The unpainted area available in annular space is given by

$$\text{Area} = \pi \left[(b^2 - a^2) - \frac{n}{4}(b-a)^2 \right]$$

Hence, the correct option is (C).

3.88 (C)



Line a and b are perpendicular to each other in X - Y plane. Let α be the acute angle made by line a with X axis. Let β be the acute angle made by line b with X axis.

The angle made by a line with the dotted line (shown in figure) is same as the angle made by it with the X -axis.

$$\therefore \alpha + \beta = 90^\circ$$

Hence, the correct option is (C).

3.89 (C)

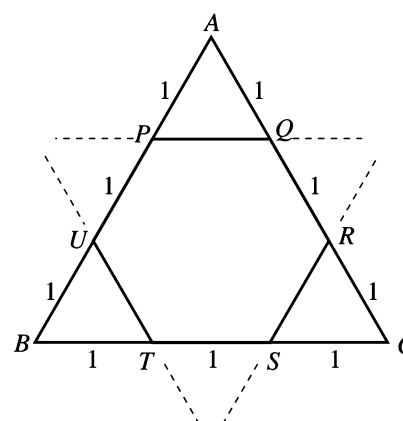
Given matrix $M = [m_{ij}]$, $i, j = 1, 2, 3, 4$ and the diagonal elements are all zero and $m_{ij} = -m_{ji}$. So we can represent the matrix as follows :

$$\begin{bmatrix} 0 & - & - & - \\ - & 0 & - & - \\ - & - & 0 & - \\ - & - & - & 0 \end{bmatrix}$$

The numbers which are connected by arrows will be the same in magnitude and opposite in sign. So the minimum number of elements required to fully specify the matrix is just 6 and other will be known accordingly.

3.90 (D)

Given :



Sides of Hexagon formed by an equilateral triangle to the same equilateral triangle = 1 : 3

The ratio of the area of the regular convex Hexagon ($PQRSTU$) to the area of original equilateral triangle is

$$\text{Area of hexagon} = \frac{3\sqrt{3}}{2} (\text{Side})^2$$

$$\text{Since, area of equilateral triangles} = \frac{\sqrt{3}}{4} (\text{Side})^2$$

$$\text{Thus, } \frac{3\sqrt{3}}{2} (1)^2 : \frac{\sqrt{3}}{4} (3)^2$$

$$\frac{3\sqrt{3}}{2} : \frac{9\sqrt{3}}{4}$$

$$2 : 3$$

The ratio of the area of the regular convex hexagon to the area of original equilateral triangle is 2 : 3.

Hence, the correct option is (D).

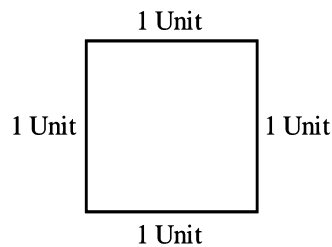
Key Point

$$\text{Area of hexagon} = \frac{3\sqrt{3}}{2} (\text{Side})^2$$

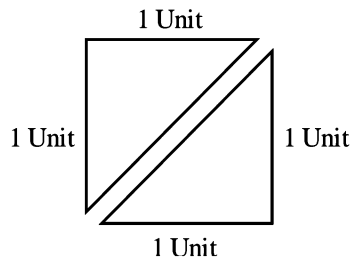
$$\text{Area of equilateral triangles} = \frac{\sqrt{3}}{4} (\text{Side})^2$$

3.91 (C)

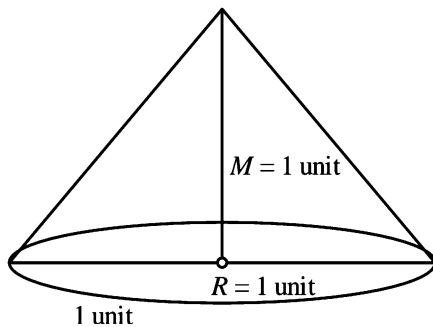
Given :



It is cut along the main diagonal to get two triangles



One of the cut triangle is revolved about its short edge to form solid cone



$$\therefore \text{The volume of cone} = \frac{1}{3} \pi R^2 M$$

$$\therefore \text{The volume of a resulting cone} = \frac{1}{3} \pi (1)^2 (1) = \frac{\pi}{3}$$

The volume of a resulting cone, is $\frac{\pi}{3}$.

Hence, the correct option is (C).

3.92 (C)

Given :

The length of all segments PR, PS, QS, TR and TQ are of equal length,

$$= \frac{(n-2)}{n} \times 180^\circ$$

$$= \frac{(10-2)}{10} \times 180^\circ = 144^\circ$$

Thus, the interior angle between the sides of the polygon, in degree is 144° .

Hence, the correct option is (C).

3.93 (B)

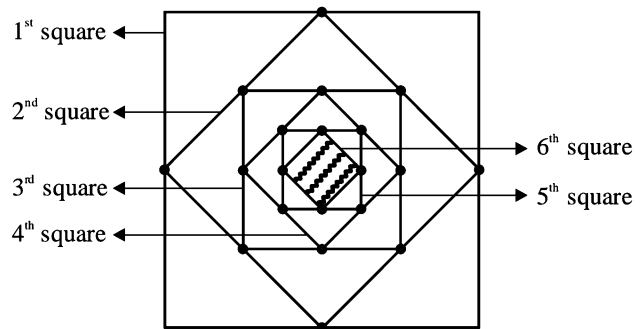
Given :

Side of outer square = 10 cm

Side of inner square = Diagonal of outer square

$$\text{Side of inner square} = \frac{\text{Side of outer square}}{\sqrt{2}}$$

Side of square :



$$\text{Thus, side of 2nd square} = \frac{10}{\sqrt{2}} = 5\sqrt{2} \text{ cm}$$

Similarly,

$$\text{Side of 3rd square} = \frac{5\sqrt{2}}{2} \times \sqrt{2} = 5 \text{ cm}$$

$$\text{Side of 4th square} = \frac{5}{2} \times \sqrt{2} = \frac{5\sqrt{2}}{2} \text{ cm}$$

$$\text{Side of 5th square} = \frac{5\sqrt{2}}{2 \times 2} \times \sqrt{2} = \frac{5}{2} = 2.5 \text{ cm}$$

$$\text{Side of 6th square} = \frac{2.5}{2} \times \sqrt{2}$$

$$\text{Thus, the area of smallest square} = \left(\frac{2.5 \times \sqrt{2}}{2} \right)^2$$

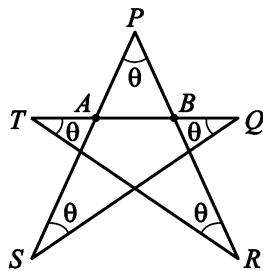
$$= 3.125 \text{ cm}^2$$

Hence, the correct option is (B).

3.94

(A)

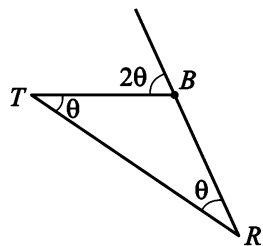
Given : In the figure the length of segments are of equal length,



Therefore, $\angle P = \angle T = \angle S = \angle R = \angle Q = \theta$

(Equal sides of triangle have equal angle)

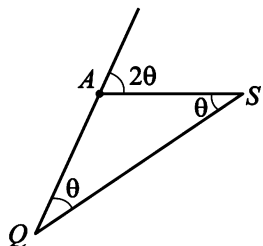
In $\triangle TBR$,



$$\text{Ext } \angle B = 2\theta \quad \dots (i)$$

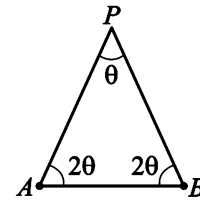
(Sum of opposite interior angle = Exterior angle)

In $\triangle QAS$,



$$\text{Ext } \angle A = 2\theta \quad \dots (ii)$$

In $\triangle PAB$,



Since, sum of all interior angles in a $\Delta = 180^\circ$.

$$\text{Thus, } \theta + 2\theta + 2\theta = 180^\circ$$

$$\theta = 36^\circ$$

Hence, the correct option is (A).

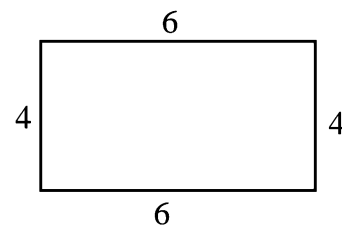
3.95

(C)

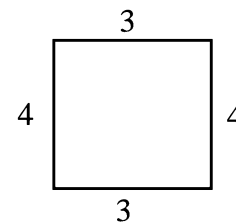
Given :

According to the given data, we can proceed step by step as given below,

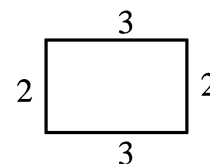
M



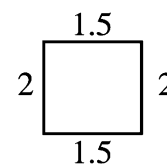
1st folding : (Respective of short edges)



2nd folding : (Respective of short side)

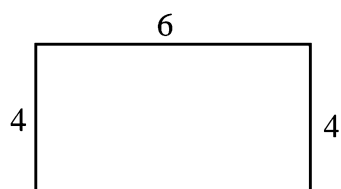
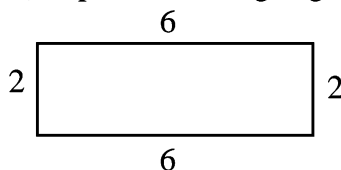
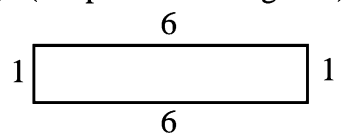
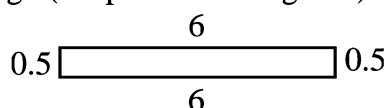


3rd folding : (Respective of short side)



Perimeter of folded shape of sheet M = 7

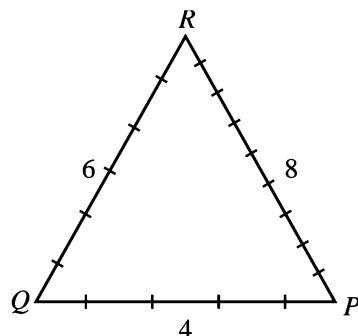
N

1st folding : (Respective of long edges)2nd folding : (Respective of long side)3rd folding : (Respective of long side)

Perimeter of folded shape of sheet N = 13

∴ Ratio of perimeters of the final folded shape of sheet N to the final folded shape of sheet M is **13:7**.

Hence, the correct option is (C).

3.96 (B)Given : Area of square = $A_{sq} = \pi^2$ 

For $\left(\frac{a}{4}, \frac{a}{6}, \frac{a}{8}\right)$ to be integer, A must be LCM of

4, 6 and 8.

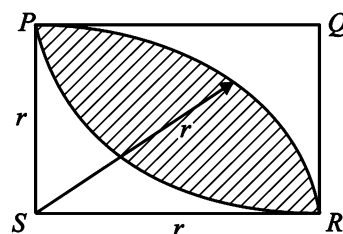
So, $a = 24$ cm

$$\text{Area} = \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times 24^2 = 144\sqrt{3} \text{ cm}^2$$

Hence, the correct option is (B).

3.97 (C)

Given :



$$\text{Probability} = \frac{fA}{TA}$$

$$fA = \left(\frac{\pi r^2}{4} - \frac{r^2}{2} \right) \times 2$$

$$\frac{fA}{TA} = \frac{\left(\frac{\pi r^2}{4} - \frac{r^2}{2} \right) \times 2}{r^2} = \left(\frac{\pi}{2} - 1 \right)$$

The probability that any point picked randomly within square falls in shaded area is $\frac{\pi}{2} - 1$.

Hence, the correct option is (C).

3.98 (C)

Given :

Area of triangle $MNO = 50 \text{ cm}^2$

$$\frac{1}{2} \times OM \times ON = 50$$

Since, the radius of circle is $OM = ON = r$

$$\text{Therefore, } \frac{1}{2} \times r^2 = 50$$

$$r^2 = 100$$

$$r = 10$$

Then, area of the circle = $\pi r^2 = \pi(10)^2$

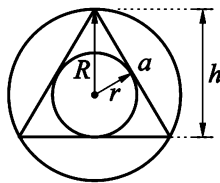
$$= 100\pi \text{ cm}^2$$

Hence, the correct option is (C).

3.99

(D)

Given :

Let, side of triangle is a ,

Since it is an equilateral triangle

Height of the triangle, $h = \sqrt{3}a$ Radius of smaller circle, $r = \frac{1}{3}h$ Radius of larger circle, $R = \frac{2}{3}h$

$$\frac{(\text{Perimeter})_{\text{small}}}{(\text{Perimeter})_{\text{large}}} = \frac{2\pi r}{2\pi R} = \frac{r}{R} = \frac{1}{2}$$

$$\frac{(\text{Area})_{\text{small}}}{(\text{Area})_{\text{large}}} = \frac{\pi r^2}{\pi R^2} = \left(\frac{r}{R}\right)^2 = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

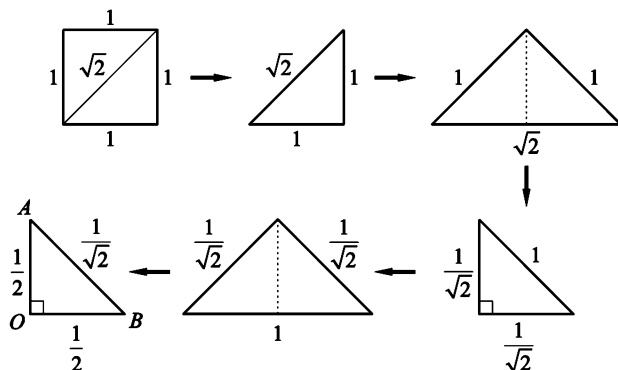
Thus, the ratio of the area of the inscribed circle to the area of the circumscribed circle of an equilateral triangle is $\frac{1}{4}$.

Hence, the correct option is (D).

3.100

(A)

Given :



$$AO = \sqrt{AB^2 - OB^2}$$

$$AO = \sqrt{\frac{1}{2} - \frac{1}{4}} = \frac{1}{2}$$

$$\text{Area of } \triangle AOB = \frac{1}{2} BO \times OA$$

$$\triangle AOB = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8} \text{ Square unit}$$

Thus, the area of each face of the final folded shape is $\frac{1}{8}$ square units.

Hence, the correct option is (A).

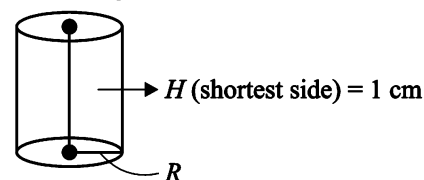
3.101

(A)

Given :

The dimension of rectangular sheet M and N = $6 \text{ cm} \times 1 \text{ cm}$

According to the question,

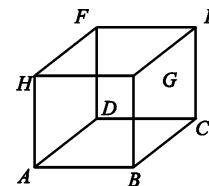
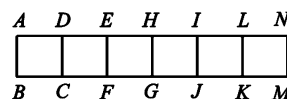
 M is folded along shortest side to form a cylinder,

$$2\pi R = 6 \text{ cm}$$

$$R = \frac{3}{\pi} \text{ cm}$$

Volume of a right circular cylinder = $\pi R^2 H$

$$\text{Volume of folded figure} = \pi \times \frac{3}{\pi} \times \frac{3}{\pi} \times 1 = \frac{9}{\pi} \text{ cm}^3$$

 N is cutted as square to form a cube i.e.Since, Volume of cube = $(\text{Side})^3$ Thus, Volume of formed cube from $N = 1 \text{ cm}^3$

The ratio of volume of cylinder to cube

$$= \frac{9/\pi}{1} = 9 : \pi$$

Thus, ratio of the volume of the cylinder to that of the cube is $9 : \pi$.

Hence, the correct option is (A).

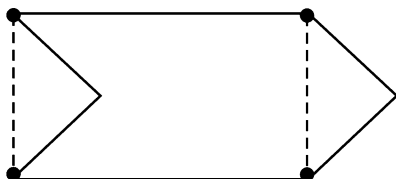
Key Point

Volume of a right circular cylinder $= \pi R^2 H$

Volume of cube $= (\text{Side})^3$

3.102 (C)**Method 1**

From option (C),

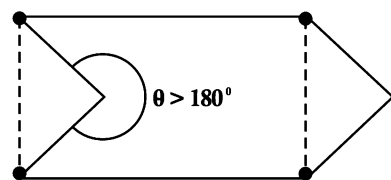


Clearly, we can see that some part is outside the segment line.

Hence, the correct option is (C).

Method 2

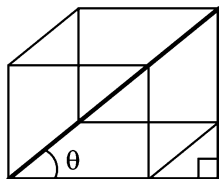
Concave polygon is one who have one interior angle more than 180° .



Hence, the correct option is (C).

3.103 (A)

Given :



$$\cos \theta = \frac{\text{Adjacent side}}{\text{Hypotenuse}}$$

Diagonal of a cube $= \sqrt{3}a$

Adjacent side = Each side $= a$

$$\cos \theta = \frac{a}{a\sqrt{3}} = \frac{1}{\sqrt{3}}$$

Hence, the correct option is (A).

Key Point

Diagonal of a cube $= \sqrt{3}a$

$$\cos \theta = \frac{a}{a\sqrt{3}} = \frac{1}{\sqrt{3}}$$

3.104 (C)

Given : The letters P, Q, R, S, T and U are to be placed one per vertex on regular convex hexagon.

Given conditions are as follows,

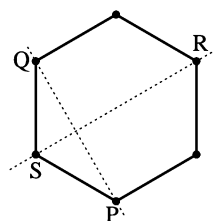
The line segment joining R and S is longer then the line segment joining P and Q.

$$RS > PQ$$

The line segment joining R and S is perpendicular to the line segment joining P and Q.

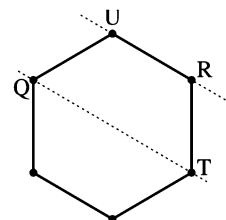
$$RS \perp PQ$$

Both the conditions are satisfying in the diagram given below,

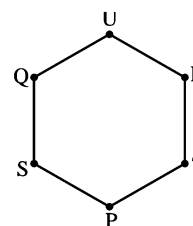


The line segment joining R and U is parallel to the line segment joining T and Q.

$$RS \parallel TQ$$



According to given conditions we can draw a diagram shown below



Option (A) is eliminated, as line TQ is not parallel to line PQ.

Option (B) is eliminated, as line QS is not perpendicular to line RP.

Option (C) is correct, as line RT is parallel to line QS.

Option (D) is eliminated, as line RP is not perpendicular to line UQ.

Hence, the correct option is (C).

3.105 (D)

Given : In First Inequality,

$$2x - 1 > 7$$

$$2x > 8$$

$$x > 4$$

And In second Inequality,

$$2x - 9 < 1$$

$$2x < 10$$

$$x < 5$$

By these two Inequalities we have value of x as $4 < x < 5$.

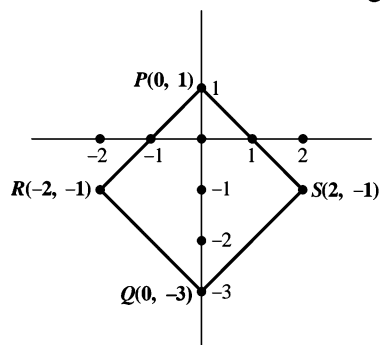
Hence, the correct option is (D).

3.106 (C)

Given : The vertices of a Quadrilateral at four points $P(0, 1)$, $Q(0, -3)$, $R(-2, -1)$ and $S(2, -1)$.

On plotting points on graph,

According to the given data a Quadrilateral $PSQR$ will form as shown in below figure,



The distance formula between two points

$$= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Length of side

$$\overline{PS} = \sqrt{(2-0)^2 + (-1-1)^2} = \sqrt{4+4} = \sqrt{8}$$

Length of side

$$\overline{QS} = \sqrt{(2-0)^2 + (-1+3)^2} = \sqrt{4+4} = \sqrt{8}$$

Length of side

$$\begin{aligned} \overline{QR} &= \sqrt{(0-(-2))^2 + \sqrt{(-3-(-1))^2}} \\ &= \sqrt{4+4} = \sqrt{8} \end{aligned}$$

Length of side

$$\overline{PR} = \sqrt{(0-(-2))^2 + \sqrt{(1-(-1))^2}} = \sqrt{4+4} = \sqrt{8}$$

Length of side $\overline{PS} = \overline{QS} = \overline{QR} = \overline{PR}$

and, length of diagonal

$$\overline{PQ} = \sqrt{(0-0)^2 + (1-(-3))^2} = 4$$

Length of diagonal

$$\overline{RS} = \sqrt{(2-(-2))^2 + (-1-(-1))^2} = 4$$

We can see clearly,

Length of diagonal $\overline{PQ} = \overline{RS}$

So, Quadrilateral $PSQR$ follows property of square.

Area of Quadrilateral $PSQR = \text{Side}^2$

Area of Quadrilateral $PSQR = (\sqrt{8})^2 = 8 \text{ Sq. unit}$

And also by,

Area of Rhombus

$$= \frac{1}{2} (\text{product of both diagonals})$$

$$= \frac{1}{2} (4 \times 4) \text{ Sq. unit} = 8 \text{ Sq. unit}$$

Hence, the correct option is (C).

3.107 (C)

Given words are,

Tire : so feel that you need to rest and sleep.

Tyre : the thick rubber thing that fits around the outside of a wheel.

Tier : one of a number of levels.

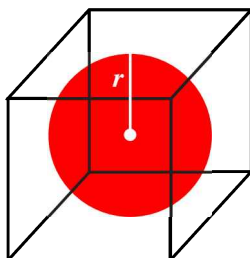
In this after term 'burning' we need object so only 'tyre' word is suitable.

So, option (A) and (D) one eliminated
And after term 'caused' or only term 'tire' is suitable.

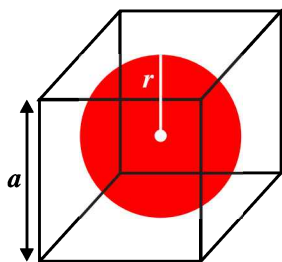
Hence, the correct option is (C).

3.108 (C)

Given : Radius of the Sphere is r cm



Consider, the side of a Cubical box is a cm



$$\text{Radius of Sphere } (r) = \frac{a}{2}$$

$$\begin{aligned} \text{Side of given Cubical box (in terms of } r) \\ = 2 \times \text{Radius of the sphere} = 2r \end{aligned}$$

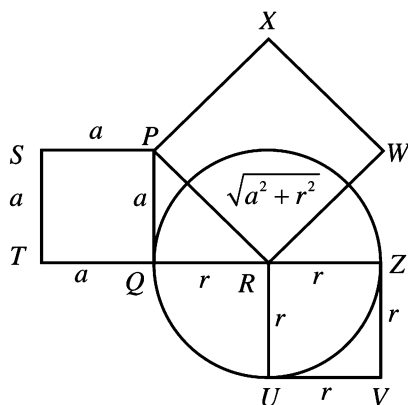
$$\text{Volume of Cubical box} = (\text{Side})^3$$

$$\begin{aligned} \text{Volume of Cubical box (in terms of } r) \\ = (2r)^3 = 8r^3 \end{aligned}$$

Hence, the correct option is (C).

3.109 (B)

Given :



Assume in $\square SPQT$, let the side $= a$

$$\therefore SP = PQ = QT = ST = a$$

From given diagram, we observed that in $\square RUVZ$.

$$\therefore RU = UV = VZ = ZR = r$$

$$Ar (\square SPQT) = a^2$$

$$Ar (\square PXWR) = a^2 + r^2$$

$$Ar (\square RUVZ) = r^2$$

$$Ar (\square SPQT) = Ar (\square PXWR) - Ar (\square RUVZ)$$

Hence, the correct option is (B).

3.110 (B)

Given : A survey of 450 students about their subject of interest resulted in the following outcome.

150 students are interested in mathematics.

200 students are interested in physics.

175 students are interested in chemistry.

30 students are interested in mathematics physics and chemistry.

50 students are interested in mathematics and physics.

So, the number of students interested in only mathematics and physics is, $50 - 30 = 20$.

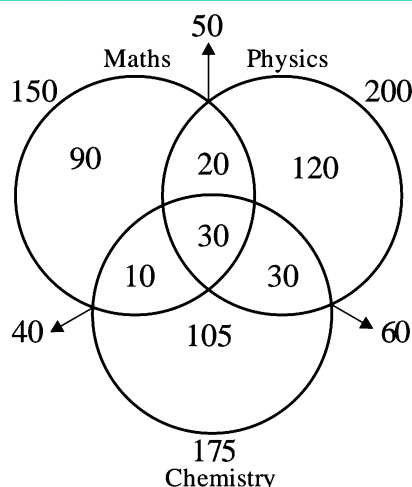
60 students are interested in physics and chemistry.

So, the number of students interested in only physics and chemistry is, $60 - 30 = 30$.

40 students are interested in mathematics and chemistry.

So, the number of students interested in only mathematics and chemistry is, $40 - 30 = 10$.

Below figure shows the Venn diagram according to the given data,



As remaining students are interested in humanities,

The total number of students interested in humanities can be calculated as

(Only Maths + only Physics + only Chemistry + Only Maths and Physics + Only Physics and Chemistry + Only Chemistry and Maths + All three Maths, Physics and Chemistry) – Total number of students

$$90 + 120 + 105 + 20 + 30 + 10 + 30 = 405$$

$$450 - 405 = 45$$

45 students are interested in humanities,

Hence, the correct option is (B).

3.111 (D)

$$L_1 : 2x - 3y = 5$$

$$L_2 : 3x + 2y = 8$$

$$L_3 : 4x - 6y = 5$$

$$L_4 : 6x - 9y = 6$$

For lines to be parallel,

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$

$$\text{Here in } L_3 \& L_4 : \frac{4}{6} = \frac{-6}{-9} \neq \frac{5}{6}$$

∴ $L_3 \& L_4$ are parallel to each other

When two lines are perpendicular, the product of their slope is -1 .

$$\text{Slope of line} = \frac{-a}{b}$$

$$\text{Slope of } L_2 = \frac{-3}{2}$$

$$\text{Slope of } L_4 = \frac{-6}{-9}$$

$$\text{Slope of } L_2 \times \text{slope of } L_4 = \frac{-3}{2} \times \frac{-6}{-9} = -1$$

∴ $L_2 \& L_4$ are perpendicular to each other

Hence, the correct option is (D).

3.112 (A)

In a 12 hour duration second, minute and hour hands of clock can be coincide, 11 times.

In every 1 hour hands of a clock will coincide one time and in 12 hour period hands of a clock will coincide only for 11 time as between 11 to 1 hands will be coincided only for 1 time at exactly 12.

Hence, the correct option is (A).

3.113 (C)

$$\begin{aligned} 2 - 5x &\leq -\frac{6x-5}{3} \\ &= 3(2-5x) \leq -(6x-5) \\ &= 6-15x \leq -6x+5 \\ &= 1 \leq 9x \\ &x \geq \frac{1}{9} \end{aligned}$$

Hence, the correct option is (C).

3.114 (A)

Given :

A person was born on the fifth Monday of February in a particular year.

Then, that year should be a leap year, as in a leap year February month is of 29 days.

If 1st February is Monday then next Monday is on 8th, 15th, 22nd and 29th of the month.

So 1st and last day of the month February will be same.

Here, the 2nd February of that year is a Tuesday.

Hence, the correct option is (A).

3.115 (B)

Given : Two functions of time (t),

$$f(t) = 0.01t^2$$

$$g(t) = 4t$$

Where $0 < t < \infty$.

Statements (i), for some $t > 0$, $g(t) > f(t)$ is true.

For example, if $t = 1$, $g(t) = 4$, $f(t) = 0.01$

Hence, $g(t) > f(t)$ for some $t = 1$.

Statement (ii), there exists a T , such that $f(t) > g(t)$ for all $t > T$. There exist $T = 400$ such that $f(t) > g(t) \forall t > 400$, it is true.

Here, both statement (i) and (ii) are correct.

Hence, the correct option is (B).

3.116 (A)

Given : The minute hand and second hand of a clock cross each other one time in every minute but in one hour (60 minute) minute hand and second hand crosses each other only for 59 times.

For an example, in between 9:00 to 10:00 in one hours they will cross each other for 59 times.

The time period in which minute hand and second hand does not cross each other is from 9:00 to 9:01.

As at 9:00 minute hand and second hand are already coincided and when second hand starts rotating it will not be coincide with hour hand till 9:01.

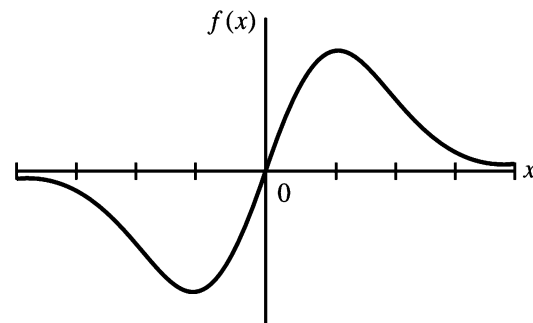
The given time period is from 9:15 am to 9:45 am total minutes are 30.

In these 30 minutes, minute hand and second hand will cross each other for 30 times.

Hence, the correct option is (A).

3.117 (B)

Given : A graph represents $f(x)$ versus x .



According the graph, $f(x) = x^2 - |x|$ is the only add function.

Hence, the correct option is (B).

3.118 (C)

Given : The smallest number with distinct digits whose digits adds up to 45

- (A) 99999, the digits of this number are not distinct, so it is not correct.
- (B) 123457869, the digits of this number are distinct, so it is correct.
- (C) 123456789, the digits of this number are distinct, so it is correct.
- (D) 123555789, the digits of this number are not distinct, so it is not correct.

As we need the smallest number with distinct digits whose digits adds up to 45.

Option (B) and (C) both followed this condition. Here, the number in option (C) is less than the number in option (B).

Hence, the correct option is (C).

3.119 (D)

Given : Forestland is a planet inhabited by different kinds of creatures. Among other creatures, it is populated by animals all of whom are ferocious. There are also creatures that have claws, and some that do not. All creatures that have claws are ferocious.

Option (A) cannot be inferred as, it is not necessary condition that all creature with claws are animals.

Option (B) cannot be inferred as, all creatures that have claws are ferocious is given in the passage.

Option (C) can also not be inferred as, all creatures that have claws are ferocious is given in the passage.

Option (D) can be inferred certainly as, "There are also creatures that have claws, and some that do not. All creatures that have claws are ferocious." Is mention in the passage. From this we can conclude some ferocious creatures are creatures with claws.

Hence, the correct option is (D).

3.120 (D)

Given : The village was nested in a green spot, between the ocean and the hills.

Hence, the correct option is (D).

3.121 (D)

Given : A frabjous number is 3 digit number with all add digits, and no two (adjacent) digits being the same.

Total number of frabjous number can be find as
add digits = 1, 3, 5, 7, 9.

Total add digits = 5

Let the three digits number be abc .

a , can be any of the 5 choices.

Since, adjacent digits do not repeat.

b , can be any of the remaining 4 choices.

c , can be any of the remaining 3 choices.

Here, numbers such as Y5Y will also be frabjous. Since, the criteria is that only adjacent digits are not same. Alternate digits (a and c) can be same.

So, total frabjous numbers, $5 \times 4 \times 4 = 80$

Hence, the correct option is (D).

3.122 (A)

Given : According to the rules, number of possible ways for Ankita to climb 5 stairs
 $1 + 1 + 1 + 1 + 1$

$$2 + 1 + 1 + 1$$

$$1 + 2 + 1 + 1$$

$$1 + 1 + 2 + 1$$

$$1 + 1 + 1 + 2$$

$$2 + 2 + 1$$

$$2 + 1 + 2$$

$$1 + 2 + 2$$

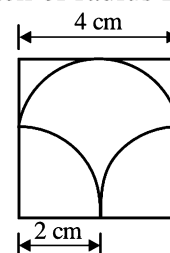
Note : Number denotes the total number of stairs climbed in one go.

Total possible ways are 8.

Hence, the correct option is (A).

3.123 (A)

Given : A square of side length 4 cm is given. The boundary of the shaded region is defined by one semi-circle on the top and two circular arcs at the bottom, each of radius 2 cm, as shown.



The area of the shaded region can be find as,

$$\text{Bottom shaded area (A)} = 2 \times \frac{1}{4} \pi (2)^2 = 2\pi$$

$$\text{Top shaded area} = 4 \times 2 - \frac{\pi \times 2^2}{2} = 8 - 2\pi$$

$$\text{Total shaded area} = 8 - 2\pi + 2\pi = 8$$

Hence, the correct option is (A).

3.124 (C)

Given : x satisfies the equation $4^{8^x} = 256$, then x is equal to.

Taking log to the base 4, on both side,

$$8^x = \log_4 256 = 4$$

Taking log to the base 8 on both side, we get

$$x = \log_8 4 = \log_2 2^2$$

$$\text{So, } x = \frac{2}{3}$$

Hence, the correct option is (C).

3.125 (C)

Given : A real number $x > 1$

$$\frac{1}{\log_2 x} + \frac{1}{\log_3 x} + \frac{1}{\log_4 x} = 1$$

$$\left[\because \frac{1}{\log_a b} = \log_b a \right]$$

$$\log_x 2 + \log_x 3 + \log_x 4 = 1$$

$$\left[\because \log_a p + \log_a q + \log_a r = \log_a (pqr) \right]$$

$$\log_x (2 \times 3 \times 4) = 1$$

$$\log_x (24) = 1 \quad \left[\because \log_a a = 1 \right]$$

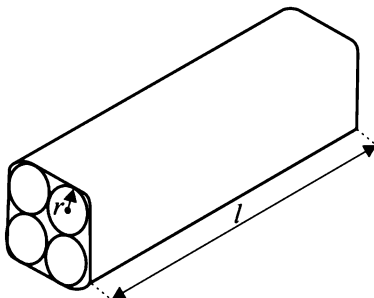
$$x = 24$$

Hence, the correct option is (C).

3.126 (D)

Given : Radius of chalk stick $r = 0.5$ cm

Length of chalk stick $l = 10$ cm



Width of duct tape is equal to length of chalk stick

Width of duct tape = 10 cm

$$\begin{aligned} \text{Length of duct tape} &= 2r + 2r + 2r + 2r + 2\pi r \\ &= 8r + 2\pi r \\ &= 8 \times 0.5 + 2\pi(0.5) \\ &= 4 + \pi \end{aligned}$$

$$\begin{aligned} \text{Area of tape} &= \text{length} \times \text{width} \\ &= 10(4 + \pi) \end{aligned}$$

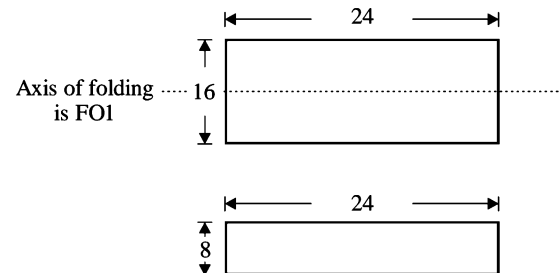
Hence the correct option is (D).

3.127 (A)

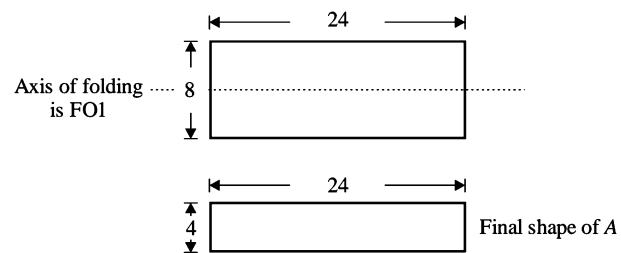
Given : Two identical sheets A and B of dimensions $24\text{cm} \times 16\text{cm}$

Case I : Sheet A is folded twice using FO1. In FO1 the axis of folding remains parallel to the initial long edge

Folding first time using FO1 sheet A becomes



Folding second time using FO1 sheet A becomes



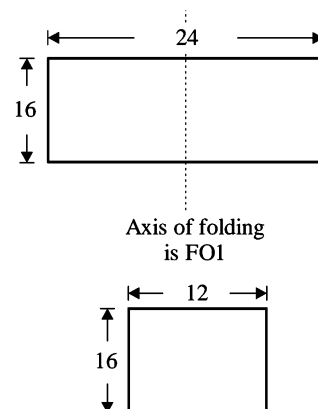
Perimeter of final shape of A after folding twice using FO1 = $2(L + B)$

$$\begin{aligned} &= 2(24 + 4) \\ &= 56 \text{ cm} \end{aligned}$$

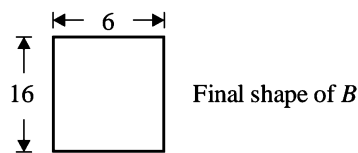
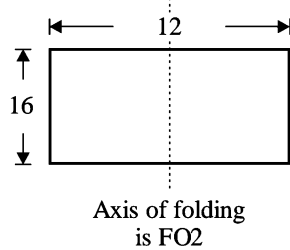
Case II : Sheet B is folded twice using FO2

In FO2 the axis of folding remains parallel to the initial short edge.

Folding first time using FO2 sheet B becomes



Folding second time using FO2 sheet B becomes



Perimeter of final shape of B after folding twice using FO2 = 2 (L + B)

$$= 2(16 + 6)$$

$$= 2(22)$$

$$= 44 \text{ cm}$$

Ratio of perimeters of the final shapes of A and B = 56 : 44

$$= 14 : 11$$

Hence, the correct option is (A).

3.128 (D)

Method 1

Decimal to octal conversion using by direct method :

To convert a decimal number to an octal number directly you must start dividing the number by 8 unit you get 0 as the quotient. This is a straight forward method that involves dividing the number to be converted

Step 1 : If decimal number is N. Divide it by 8. Because the octal number systems base is 8.

Step 2 : Note the value of the residual which will be one of the flowing: 0, 1, 2, 3, 4, 5, 6 or 7. Divide the remaining decimal number unit it equals 0 and record the remainder of each step.

Step 3 : Then from bottom to top write the remainder which will be the equivalent octal number of the provided decimal number.

Given : Decimal number = 108

8	108		MSD
8	13	4	
8	1	5	
	0	1	LSD

$(108)_{10} = (154)_8$

Method 2

Convert decimal to binary to octal

Step 1 : Divide the Number by 2

Step 2 : Get the integer quotient for next iteration.

Step 3 : Get the remainder for the binary digit

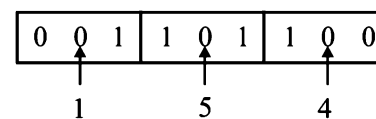
Step 4 : Repeat the above steps until the quotient is equal to 0.

Given : Decimal number = 108

2	108		MSD
2	54	0	
2	27	0	
2	13	1	
2	6	1	
2	3	0	
2	1	1	
		1	LSD

$$(108)_{10} = (1101100)_2$$

Now convert binary number into an octal number



$$(108)_{10} = (154)_8$$

Hence, the correct option is (D).

3.129 MTA

Given figure is represent the geometry similar to the Rhombus.

Note :

1. Diagonals of a rohmBUS intersect each other at 90°
2. All sides of a rohmBUS are equal in length
3. Adjacent angles add up to 180° .

So, in a rhombus $\rightarrow$ from figure.

$$CD = AD = AF = FC$$

Given :

- (i) $CD = 5$ cm
 (ii) $AE = 12$ cm
 (iii) $BE = 10$ cm
 then $CD = AD = AF = FC = 5$ cm
 (iv) $\angle DAB = \angle DCB$ and
 $\angle DAE = \angle DBC = 90^\circ$
 then $\angle DBC = \angle DBA = \angle ABF =$
 $\angle FBC = 90^\circ$

in $\triangle DAE$:

$$(DE)^2 = (DA)^2 + (AE)^2$$

$$DE = \sqrt{(5)^2 + (12)^2} = 13 \text{ cm}$$

$$DE = DB + BE \Rightarrow DB = DE - BE$$

$$DB = 13 - 10 = 3 \text{ cm}$$

$$\therefore DB = 3 \text{ cm} = BF$$

$$\therefore DB = BF$$

From property -1 above.

$$DB = BF = 3 \text{ cm}$$

Statement - I in $\triangle ABF$

$$(AF)^2 = (AB)^2 + (BF)^2$$

$$AB = \sqrt{(AF)^2 - (BF)^2}$$

$$AB = \sqrt{(5)^2 - (3)^2} = 4 \text{ cm}$$

$$\therefore AF = CD = 5 \text{ cm}$$

$$AB = 4 \text{ cm}$$

Statement - II in $\triangle ABE$

$$(AE)^2 = (AB)^2 + (BE)^2$$

$$AB = \sqrt{(AE)^2 - (BE)^2}$$

$$AB = \sqrt{(12)^2 - (10)^2} = \sqrt{44} \text{ cm}$$

For the same figure value of "AB" is came different.

$$\therefore AB = 4 \text{ cm} \neq AB = \sqrt{44} \text{ cm}$$

So, this reasons the given data and given figure did not match properly hence M.T.A.

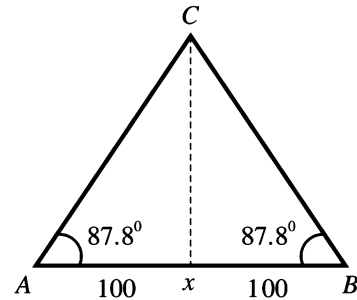
3.130 (B)

Object B translate towards the left direction.

Hence, the correct option is (B).

3.131 (A)

According to given data :



$$\tan \theta = \frac{cx}{Ax}$$

$$\tan(87.8^\circ) = \frac{cx}{100}$$

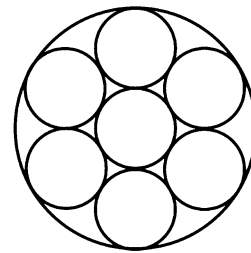
$$cx = 100 \times \tan(87.8^\circ)$$

$$cx = 2603$$

Hence, the correct option is (A).

3.132 (B)

Given : Seven identical cylindrical chalk sticks are fitted tightly in a cylindrical container as shown in figure.

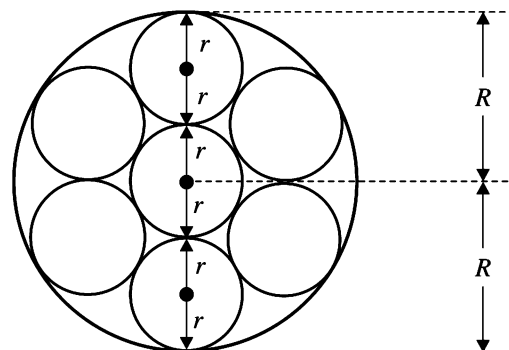


and length of container = Length of chalk sticks

Let the length of container and chalk stick = l

Let the radius of cylinder = R

Let the radius of chalk stick = r



From the above figure

$$R + R = r + r + r + r + r + r$$

$$2R = 6r$$

$$r = \frac{2}{6}R$$

$$r = \frac{R}{3} \quad \dots(i)$$

Now volume of cylinder

$$= \pi R^2 h$$

$$= \pi R^2 l$$

Volume of chalk stick

$$= \pi r^2 h$$

$$= \pi r^2 l$$

$$= \pi \left(\frac{R}{3} \right)^2 l \quad [\text{From equation (i) } r = \frac{R}{3}]$$

$$= \pi \frac{R^2}{9} l$$

Occupied space of container

$$= 7 \times \text{Volume of chalk stick}$$

$$= 7\pi \frac{R^2}{9} l$$

Empty space of container

$$= [\text{Volume of cylinder}] - 7(\text{Volume of chalk sticks})$$

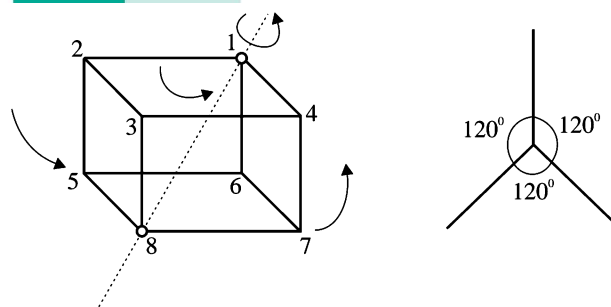
$$= \pi R^2 l - \frac{7}{9} \pi R^2 l$$

Ratio of occupied space to empty space of the container

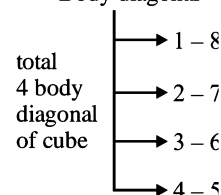
$$\begin{aligned} &= \frac{7\pi \frac{R^2}{9} l}{\pi R^2 l - \frac{7}{9} \pi R^2 l} = \frac{\left(\frac{7}{9} \right) \pi R^2 l}{\left[1 - \frac{7}{9} \right] \pi R^2 l} \\ &= \frac{\frac{7}{9}}{\frac{2}{9}} = \frac{7}{2} \end{aligned}$$

Hence, the correct option is (B).

3.133 (A)



Body diagonal



- When the cube is rotated that is held with one of the four body diagonals.
- Rotating a cube 120° along its body diagonal is one of the symmetries of cube it preserves the cube's shape and orientation and keep the view unchanged, occupy same space.

Hence, the correct option is (A).

3.134 (A)

Given : Positive integers p and q , $\frac{p}{q} \neq 1$

and $\left(\frac{p}{q} \right)^{\frac{p}{q}} = p^{\left(\frac{p-1}{q} \right)}$

$$\left[\because \left(\frac{x}{y} \right)^m = \frac{x^m}{y^m}, (xy)^m = x^m \cdot y^m \right]$$

$$\frac{p^{p/q}}{q^{p/q}} = p^{p/q} p^{-1}$$

$$\frac{p^{p/q}}{q^{p/q}} = \frac{p^{p/q}}{p}$$

$$p p^{p/q} = q^{p/q} p^{p/q}$$

$$p = q^{p/q}$$

$$p = (q^{1/q})^p$$

$$[\because (x^m)^n = x^{mn}]$$

Taking $\frac{1}{p}$ in exponent on both sides

$$p^{1/p} = q^{1/q}$$

Taking pq in exponent on both sides

$$(p^{1/p})^{pq} = (q^{1/q})^{pq} \quad [\because (x^m)^n = x^{mn}]$$

$$p^{pq/p} = q^{pq/q}$$

$$p^q = q^p$$

Hence, the correct option is (A).

3.135 (C)

1	1	2	
2	X	③	
2	X	4	
1	2	X	

All element which are came on this boundary, is neighbors of 3 = total neighbors of 3

1 cross available in neigh of this

1	1	2	
2	X	③	
2	X	4	
1	2	X	

For this 2 cross available in neigh.

1 cross would be possible in both of them

1 cross didn't come

1 cross can be possible

But we want to required maximum number of crosses.

So for this situation

So For this situation	X	→	$\left(\begin{array}{c} \text{Maximum} \\ \text{Crosses} \end{array} \right) = 2$
	X		

Hence, the correct option is (C).

3.136 (A)

Given : Real variables x, y, z and the real constant p, q, r

$$\frac{x}{pq-r^2} = \frac{y}{qr-p^2} = \frac{z}{rp-q^2}$$

Let, $\frac{x}{pq-r^2} = \frac{y}{qr-p^2} = \frac{z}{rp-q^2} = k \quad \dots(i)$

From equation (i)

$$\frac{x}{pq-r^2} = k$$

$$x = k(pq-r^2)$$

Multiply by p on both sides

$$px = k(p^2q - pr^2) \quad \dots(ii)$$

From equation (i)

$$\frac{y}{qr-p^2} = k$$

$$y = k(qr-p^2)$$

Multiply by q on both sides

$$qy = k(q^2r - p^2q) \quad \dots(iii)$$

From equation (i)

$$\frac{z}{rp-q^2} = k$$

$$z = k(rp-q^2)$$

Multiply by r on both sides

$$rz = k(r^2p - q^2r) \quad \dots(iv)$$

Adding equation (ii), (iii), (iv)

$$\begin{aligned} px + qy + rz &= k(p^2q - pr^2) \\ &\quad + k(q^2r - p^2q) + k(r^2p - q^2r) \\ px + qy + rz &= k[p^2q - pr^2 + q^2r \\ &\quad - p^2q + r^2p - q^2r] \end{aligned}$$

$$px + qy + rz = k[0]$$

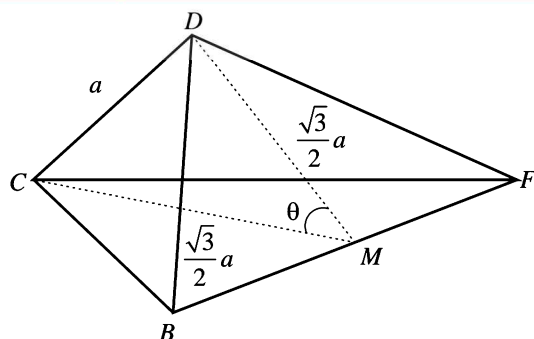
$$px + qy + rz = 0$$

Hence, the correct option is (A).

3.137 MTA

When four equilateral triangles are used to make a regular closed 3-D object then it's called a regular tetrahedron. Each interior angle of a regular tetrahedron is 60° .

We need to find angle between two faces of tetrahedron.



$M \rightarrow$ Mid point of AB

CM and $DM \rightarrow$ heights

Since to find angle between two planes of tetrahedron we connect the heights of any two triangular faces from opposite vertices with the line connecting those vertices. We get an isosceles triangle of base CD ,

$CD = a$ unit

CD and DM are the equal sides of triangle $= \frac{\sqrt{3}}{2} a$ unit

a unit

using cosine Rule

$$\cos(c) = \frac{a^2 + b^2 - c^2}{2ab}$$

using cosine Rule to find angle

$$\cos\theta = \frac{\left(\frac{\sqrt{3}}{2}a\right)^2 + \left(\frac{\sqrt{3}}{2}a\right)^2 - (a)^2}{2 \times \left(\frac{\sqrt{3}}{2}a\right) \times \left(\frac{\sqrt{3}}{2}a\right)}$$

$$\cos\theta = \frac{1}{3}$$

$$\theta = \cos^{-1}(1/3) = 70.53^\circ$$

$$\theta \approx 70.53^\circ$$

$\therefore$ DM is a line lying on ABD plane & CM is a line lying on ABC plane. So $\theta (= \angle DMC)$ is the angle between the planes ABD & ABC ($\therefore$ called as dihedral angles)

3.138 (D)

Given : Two distinct non-zero variables x and y
and $(x+y) \propto (x-y)$

$$\therefore (x+y) = k(x-y)$$

$$x+y = kx-ky$$

$$y+ky = kx-x$$

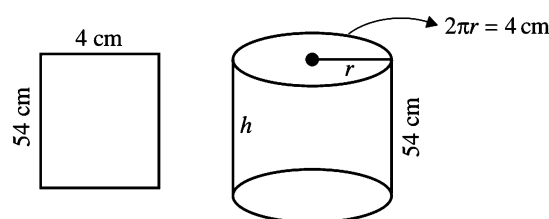
$$(k+1)y = (k-1)x$$

$$\frac{x}{y} = \frac{k+1}{k-1} = k' \text{ (Constant)}$$

$$\therefore \frac{x}{y} = \text{Constant}$$

Hence, the correct option is (D).

3.139 (A)



Surface area of rectangular sheet

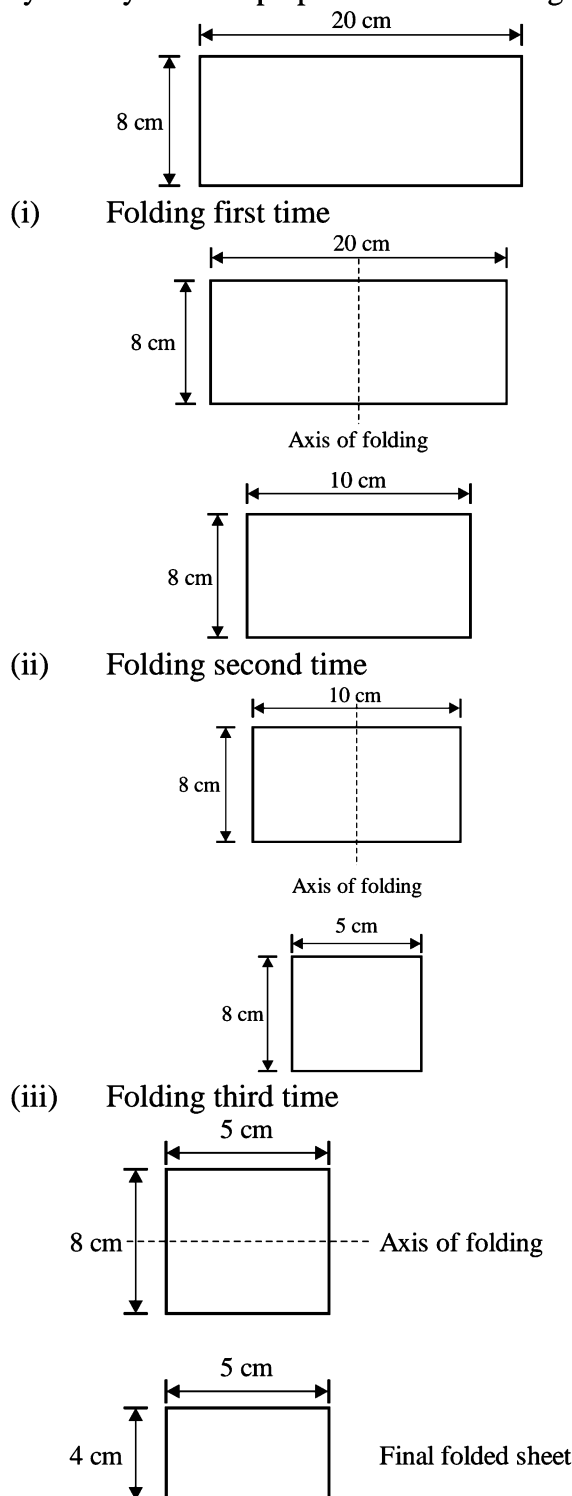
$$= 54 \times 4 = 216 \text{ cm}^2$$

- Cube surface area $= 6a^2 = 216 \text{ cm}^2$
 $a = 6 \text{ cm}$
Volume of cube $= a^3 = 6^3 = 216 \text{ cm}^3$
 - Circumference of cylinder
 $= 2\pi r = 4 \rightarrow r = \frac{2}{\pi}$
 - Volume of cylindrical tube
 $= \pi r^2 h$
 $= \pi \left(\frac{2}{\pi}\right)^2 \times 54 = \frac{216}{\pi}$
- $$\frac{\text{Volume of the cylindrical tube}}{\text{Volume of the cube}} = \frac{216/\pi}{216} = \frac{1}{\pi}$$

Hence, the correct option is (A).

3.140 (A)**Given :** Rectangular paper of 20cm×8cm

Paper is folded 3 times along the line of symmetry which is perpendicular to its long edge



Now, perimeter of final folded sheet

$$= 2(L + B)$$

$$= 2(5 + 4)$$

$$= 2(9)$$

$$= 18 \text{ cm}$$

Hence, the correct option is (A).

3.141 (C)**Given :** For positive non-zero real variables x and y ,

$$\ln\left(\frac{x+y}{2}\right) = \frac{1}{2}[\ln(x) + \ln(y)]$$

$$2\ln\left(\frac{x+y}{2}\right) = [\ln(x) + \ln(y)]$$

$$[\because \ln(m) + \ln(n) = \ln(mn)]$$

$$2\ln\left(\frac{x+y}{2}\right) = \ln(xy)$$

$$\ln\left(\frac{x+y}{2}\right)^2 = \ln(xy)$$

$$[\because k \ln(m) = \ln(m)^k]$$

Taking antilog both sides,

$$\left(\frac{x+y}{2}\right)^2 = xy$$

$$[\because (a+b)^2 = a^2 + b^2 + 2ab]$$

$$\frac{x^2 + y^2 + 2xy}{4} = xy$$

$$x^2 + y^2 = 4xy - 2xy$$

$$x^2 + y^2 = 2xy$$

$$\frac{x^2}{xy} + \frac{y^2}{xy} = 2$$

$$\frac{x}{y} + \frac{y}{x} = 2$$

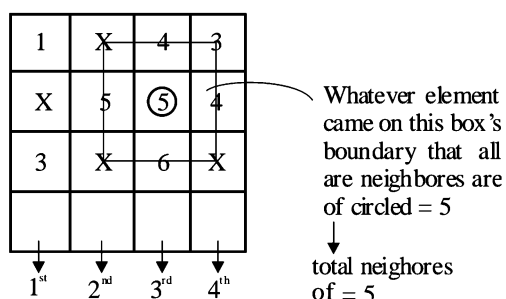
Hence, the correct option is (C).

3.142 (A)

Only 3 cuts are required to cut a cube into 8 equal size cubes. One along the x -axis, one along the y -axis and one along the z -axis.

Hence, the correct option is (A).

3.143 (A)



Ist place : It has 2 neighbors so value = 2

IInd place : It has 4 neighbors so value = 4

IIIrd place : It has 3 neighbors so value = 3

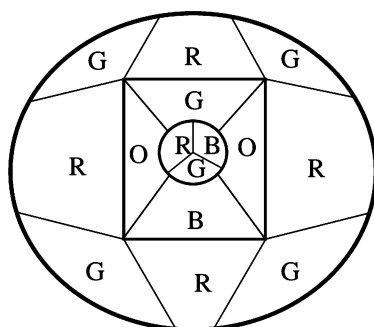
IVth place : It has 2 neighbor so value = 2

2	4	3	2
---	---	---	---

Sum of last row = $2 + 4 + 3 + 2 = 11$

Hence, the correct option is (A).

3.144 (A)

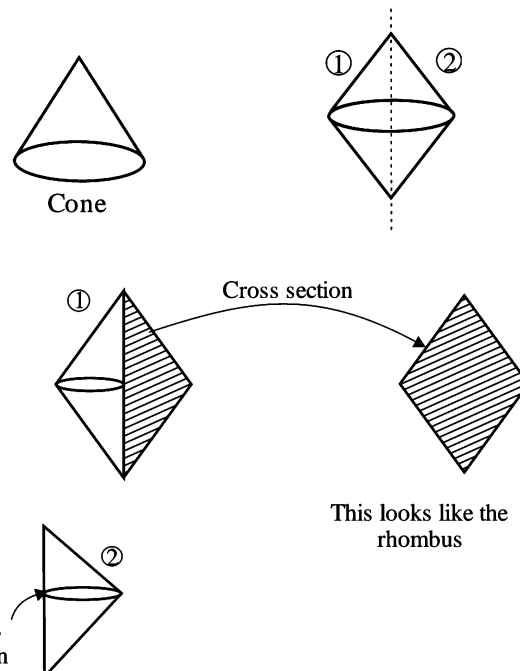


$\left\{ \begin{array}{l} O \rightarrow \text{orange colour} \\ B \rightarrow \text{Black} \\ R \rightarrow \text{Red} \\ G \rightarrow \text{Green} \end{array} \right\}$

Total minimum mo. of colors required = 4

Hence, the correct option is (A).

3.145 (A)



Hence, the correct option is (A).

3.146 (B)

Iteration 0 : There is 1 segment with a length of 1 unit.

Iteration 1 : There are 5 segments, and each segment has a length of $\frac{1}{3}$ units.

$$\text{Total length} = 5 \times \frac{1}{3} = \frac{5}{3}$$

Iteration 2 : There are 25 segments, and each segment has a length of $\frac{1}{9}$ units.

$$\text{Total length} = 25 \times \frac{1}{9} = \frac{25}{9} = \left(\frac{5}{3}\right)^2$$

From here, each subsequent iteration will increase the number of segments and their total length by a factor of $\frac{5}{3}$

$$\text{Total length after } n \text{ iteration, } L_n = \left(\frac{5}{3}\right)^n$$

Hence, the correct option is (B).

3.147 (A)

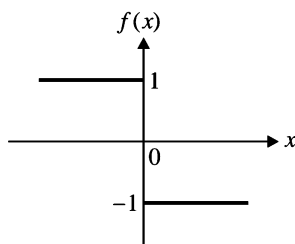
Given : $f(x) = \frac{-|x|}{x}$, where x is a non-zero real number.

Modulus function is given by :

$$|x| = \begin{cases} -x & \text{If } x < 0 \\ x & \text{If } x \geq 0 \end{cases}$$

If x is positive, $f(x) = \frac{-|x|}{x} = \frac{-x}{x} = -1$

If x is negative, $f(x) = \frac{-|x|}{x} = \frac{-(-x)}{x} = 1$



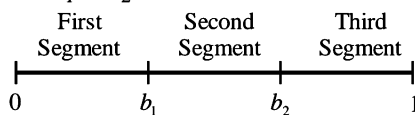
Hence, the correct option is (A).

3.148 (D)

Given :

(i) A stick of length one meter is Broken at two locations at distance of b_1 and b_2 from the origin (0).

(ii) $0 < b_1 < b_2 < 1$



Triangle inequality theorem :

A triangle can be formed if the sum of any two sides is greater than the third side.

(i) b_1 (first line (or) segment)

(ii) $b_2 - b_1$ (second line (or) segment)

(iii) $1 - b_2$ (third line (or) segment)

(1) $b_1 + (b_2 - b_1) > (1 - b_2)$

$$b_2 > 1 - b_2$$

$$2b_2 > 1$$

$$b_2 > 0.5 \text{ [Condition satisfied]}$$

$$(2) \quad b_1 + (1 - b_2) > (b_2 - b_1)$$

$$b_1 + 1 - b_2 > b_2 - b_1$$

$$2b_1 - 2b_2 + 1 > 0$$

$$b_2 < b_1 + 0.5 \text{ [Condition satisfied]}$$

$$(3) \quad (b_2 - b_1) + (1 - b_2) > b_1$$

$$b_2 - b_1 + 1 - b_2 > b_1$$

$$-2b_1 + 1 > 0$$

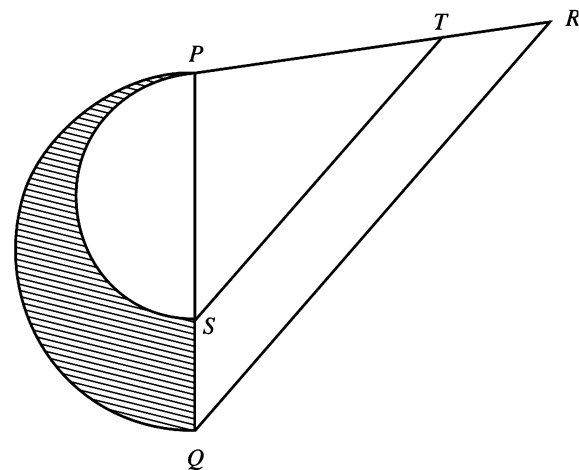
$$2b_1 < 1$$

$$b_1 < 0.5 \text{ [Condition satisfied]}$$

Hence, the correct option is (D).

3.149 (A)

Given : $PT : TR = 3 : 2$



Triangle PQR and ΔPST are similar

$$\Delta PQR \sim \Delta PST$$

For similar triangles the corresponding sides are in proportion.

$$\text{i.e.,} \quad \frac{PS}{PT} = \frac{PQ}{PR}$$

$$\frac{PS}{PQ} = \frac{PT}{PR} \quad \left[\begin{array}{l} PT : TR = 3 : 2 \\ \frac{PT}{PR} = \frac{2}{5} \end{array} \right]$$

$$\frac{PS}{PQ} = \frac{3}{5}$$

$$PQ = \frac{5}{3} PS$$

Area of semicircle with diameter $PQ = \frac{\pi}{2} R^2$

$$= \frac{\pi}{2} \left(\frac{D}{2} \right)^2 = \frac{\pi}{8} D^2 = \frac{\pi}{8} (PQ)^2$$

$$\left[\because PQ = \frac{5}{2} PS \right]$$

$$= \frac{\pi}{8} \left[\frac{5}{2} PS \right]^2 = \frac{\pi}{8} \frac{25}{4} (PS)^2$$

Area of semicircle with diameter PS

$$= \frac{\pi}{2} r^2 = \frac{\pi}{2} \left(\frac{d}{2} \right)^2 = \frac{\pi}{8} d^2 = \frac{\pi}{8} (PS)^2$$

Area of shaded region = Area of semicircle with diameter PQ – Area of semicircle with diameter PS

$$= \frac{\pi}{8} \frac{25}{4} PS^2 - \frac{\pi}{8} PS^2$$

$$= \frac{\pi}{8} PS^2 \left[\frac{25}{4} - 1 \right] = \frac{16}{8} \frac{\pi}{8} PS^2$$

Thus, the shaded area is $\frac{16}{9}$ times the area of semi circle with diameter PS .

Hence, the correct options is (A).

3.150 (A)

Given : $Pe^x = Qe^{-x}$ for all real values of x .

$$Pe^x - Qe^{-x} = 0$$

$$P - Qe^{-2x} = 0$$

$$P = Qe^{-2x} \quad \dots(i)$$

For the equation to hold for all value of x .

Case 1 : As $x \rightarrow \infty$

$e^{-2x} \rightarrow 0$, so we get $P = 0$

Case 2 : As $x \rightarrow -\infty$

$e^{-2x} \rightarrow \infty$, which means for P to remain finite, Q must be 0.

Hence, the correct option is (A).

3.151 (A)

Given : Table is shown below

Iteration (i)	0	1	2	3
Input (I)	20	-4	10	15
Output (X)	20	16	26	41
Output (Y)	20	-80	-800	-12000

From the options : Let us check each option by substituting values from the table.

From options (A) :

At $i = 1$, $X(1) = X(1-1) + I(1)$

$$X(1) = X(0) + I(1) \quad \dots(i)$$

From the table, $X(0) = 20$

$$I(1) = -4$$

$$X(1) = 16$$

From equation (i),

$$16 = 20 - 4$$

$$16 = 16$$

$$\text{L.H.S} = \text{R.H.S}$$

So, equation (i) is satisfied

Hence, $X(i) = X(i-1) + I(i)$ is correct equation

and $Y(i) = Y(1-1)I(i)$

$$i = 1$$

$$Y(i) = Y(1-1)I(i) \quad \dots(ii)$$

From the table, $Y(1) = -80$

$$Y(0) = 20$$

$$I(1) = -4$$

From equation (ii),

$$-80 = 20(-4)$$

$$-80 = -80$$

$$\text{LHS} = \text{RHS}$$

So, equation (ii) is satisfied

Thus, $Y(i) = Y(i-1)I(i)$ is correct equation.

Hence, option (A) is correct.

From option (B) :

$$X(i) = X(i-1)I(i)$$

At $i = 1$, $X(1) = X(1-1)I(1)$

$$X(1) = X(0)I(1) \quad \dots(iii)$$

From the table, $X(1) = 16$

$$X(0) = 20$$

$$I(1) = -4$$

From equation (iii),

$$16 = 20(-4)$$

$$16 \neq -80$$

$$\text{LHS} \neq \text{RHS}$$

So, equation (iii) is not satisfied

Thus, $X(i) = X(i-1)I(i)$ is not the correct equation.

and $Y(i) = Y(i-1) + I(i)$

$$i = 1$$

$$Y(1) = Y(1-1) + I(1)$$

$$Y(1) = Y(0) + I(1) \quad \dots(\text{iv})$$

From the table, $Y(1) = -80$

$$I(1) = -4$$

$$Y(0) = 20$$

From equation (iv),

$$-80 = 20 - 4$$

$$-80 \neq 16$$

$$\text{LHS} \neq \text{RHS}$$

So, equation (iv) is not satisfied

Thus, $Y(i) = Y(i-1) + I(i)$ is not the correct equation.

Hence, option (B) is not correct

From option (C) :

$$X(i) = X(i-1)I(i)$$

At $i = 1$, $X(1) = X(1-1)I(1)$

$$X(1) = X(0)I(1) \quad \dots(\text{v})$$

From the table, $X(1) = 16$

$$X(0) = 20$$

$$I(1) = -4$$

From equation (v),

$$16 = 20(-4)$$

$$16 \neq -80$$

So, equation (v) is not satisfied

Thus, $X(i) = X(i-1)I(i)$ is not the correct equation

and $Y(i) = Y(i-1)I(i)$

At $i = 1$, $Y(1) = Y(1-1)I(1)$

$$Y(1) = Y(0)I(1) \quad \dots(\text{vi})$$

From the table, $Y(1) = -80$

$$Y(0) = 20$$

$$I(1) = -4$$

From $Y(1) = Y(0)I(1)$ equation (vi)

$$-80 = 20(-4)$$

$$-80 = -80$$

$$\text{LHS} = \text{RHS}$$

So, equation (vi) is satisfied.

So, $Y(i) = Y(i-1)I(i)$ is the correct equation.

Thus, option (C) is correct

From option (D) :

$$X(i) = X(i-1) + I(i)$$

$$i = 1$$

$$X(1) = X(1-1) + I(1)$$

$$X(1) = X(0) + I(1) \quad \dots(\text{vii})$$

From the table, $X(1) = 16$

$$X(0) = 20$$

$$I(1) = -4$$

From equation (vii)

$$16 = 20 - 4$$

$$16 = 16$$

$$\text{LHS} = \text{RHS}$$

So, equation (vii) is satisfied

Hence, $X(i) = X(i-1) + I(i)$ is correct equation.

and $Y(i) = Y(i-1)I(i-1)$

$$i = 1$$

$$Y(1) = Y(1-1)I(1-1)$$

$$Y(1) = Y(0)I(0) \quad \dots(\text{viii})$$

From the table, $Y(1) = -80$

$$Y(0) = 20$$

$$I(0) = 20$$

From equation (viii),

$$Y(1) = Y(0)I(0)$$

$$-80 = 20(20)$$

$$-80 \neq 400$$

$$\text{LHS} \neq \text{RHS}$$

So, equation (viii) is not satisfied

Thus, $Y(i) = Y(i-1)I(i-1)$ is not correct equation

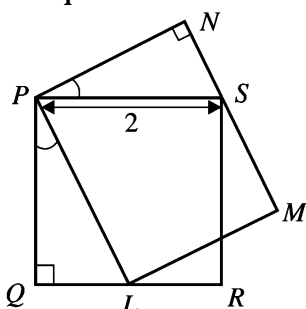
Hence, option (D) is not correct

Hence, the correct option is (A).

3.152 (D)

Given : $PQRS$ is a square of side 2 cm and $PLMN$ is a rectangle.

The corner L of the rectangle is on the side QR . Side MN of the rectangle passes through the corner S of the square.



In $\triangle PSN$, $\angle N = 90^\circ$

$$\cos \theta = \frac{PN}{PS}$$

$$PN = PS \cos \theta$$

$$PN = 2 \cos \theta$$

$$PN = LM = 2 \cos \theta$$

i.e., breadth of rectangle $PNML$ is $2 \cos \theta$ cm.

In $\triangle PQL$, $\cos \theta = \frac{PQ}{PL}$

$$PL = \frac{PQ}{\cos \theta}$$

$$PL = \frac{2}{\cos \theta}$$

$$PL = MN = \frac{2}{\cos \theta}$$

Length of rectangle $PNML$ is $\frac{2}{\cos \theta}$ cm.

Area of rectangle $PLMN$ = Length $\times$ Breadth

$$= 2 \cos \theta \times \frac{2}{\cos \theta} = 4 \text{ cm}^2$$

Hence, the correct option is (D).

3.153 (A)

To make 12 edges of 1 meter each from a 12-meter wire, you need to make 3 cuts :

1. Cut the wire into two 6-meter pieces.
2. Cut one 6-meter piece into two 3-meter pieces.
3. Cut one 3-meter piece into three 1-meter pieces.

This results in 12 pieces of 1 meter with 3 cuts.

Hence, the correct option is (A).

3.154 (C)

Given :

- (i) Rohit enters a restaurant at about 1 PM and notices that the hour and minute hands of the clock are exactly coinciding.
- (ii) After about an hour when he leaves, the hands are again exactly coinciding.

Note :

- (i) The two hands coincide at times 12:00, 1:05, 2:11, 3:16 and so on.
- (ii) These coincide every 65 minute, not 60 minute.
- (iii) They coincide 11 times in 12 hours and hence coincide 22 times in 24 hours.

The hands of clock coincide at regular intervals given by the formula :

$$T = \frac{12}{11} \times 60$$

Where,

- $\frac{12}{11}$ accounts for the relative speed of hour and minute hands.
- 60 minute is time taken for one full revolution of the minute hand.

$$T = \frac{12}{11} \times 60 = \frac{720}{11} = 65 \frac{5}{11} \text{ minute}$$

So, the hands coincide every $65 \frac{5}{11}$ minute.

Hence, the correct option is (C).

3.155 (B)

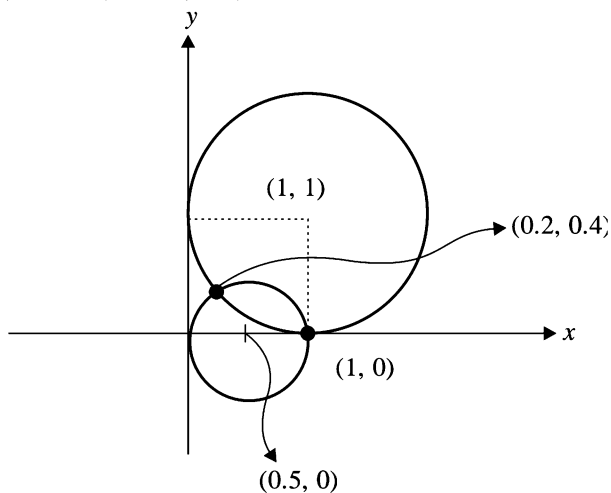
Equation of circle with centre $(0.5, 0)$ and radius $= 0.5$ is

$$(x-0.5)^2 + y^2 = (0.5)^2 \quad \dots(i)$$

Equation of circle with centre $(1,1)$ and radius $= 1$

$$(x-1)^2 + (y-1)^2 = 1^2 \quad \dots(ii)$$

Solving (i) and (ii), intersection point will be $(0.2, 0.4)$ and $(1, 0)$



Intersection points are $(1, 0)$ and $(0.2, 0.4)$

Hence, the correct option is (B).

3.156 (C)

- (i) $9 \rightarrow 1$ (ii) J
(iii) 10 (iv) $H \rightarrow 8$

N	U	F	I
21	14	9	6
H	L	J	O
12	8	15	10

Hence, the correct option is (C).

3.157 (B)

From observing given sequence

$$P^* = PRT O Q S U$$

Hence, the correct option is (B).

3.158 (C)

Given : $P < Q$

$$S > P > T$$

$$R < T$$

Combining all conditions, the possible order of all arrangements are

$$(i) \quad S > Q > P > T > R$$

OR

$$(ii) \quad Q > S > P > T > R$$

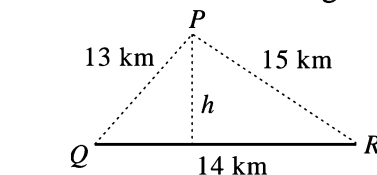
In both cases 'P' is the middle number. When integers 1 to 5 are used for arrangement P takes the value of integer '3'.

$$P = 3$$

Hence, the correct option is (C).

3.159 (C)**Method 1**

The minimum possible length for connecting roads will be the altitude of the given triangle.



$$h = \frac{2 \times \text{Area of triangle}}{\text{Base}}$$

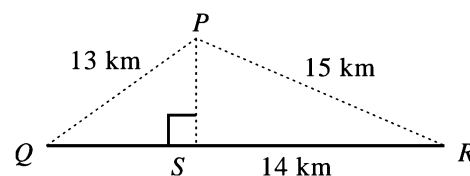
$$h = \frac{2\sqrt{s(s-a)(s-b)(s-c)}}{\text{Base}}$$

$$s = \frac{13+14+15}{2} = 21$$

$$h = \frac{2\sqrt{21 \times 8 \times 7 \times 6}}{14} = 12$$

$$h = 12 \text{ km}$$

Hence, the correct option is (C).

Method 2

Let S be the point on the line QR .

For minimum length of PS , PQS must be a right angle triplets known with hypotenuse 13 are (5, 12, 13) from options $h = 12$.

Hence, the correct option is (C).

3.160 (D)

Celling function $Ce(x)$: The smallest integer greater than or equal to x .

Floor function $fl(x)$: The largest integer less than or equal to x .

From option (A) : $Ce(x) \geq x$ [Always true]

The ceiling function round x upto nearest integer. This option is correct.

From option (B) : $fl(x) \leq x$ [Always true]

The floor function round x down, ensuring that $fl(x)$ is always less than or equal to x .

So, this option is correct.

From option (C) : $Ce(x) \geq fl(x)$ [Always true]

Since, $Ce(x)$ is atleast as large as $fl(x)$, this is always valid.

From option (D) : $fl(x) < Ce(x)$

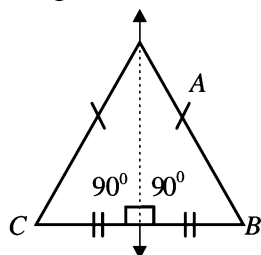
This is not true, when x is an integer because in that case $Ce(x) = fl(x)$.

Hence, the correct option is (D).

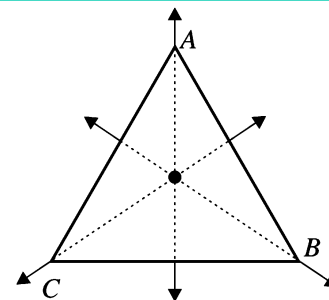
3.161 (B)

Lines of Symmetry :

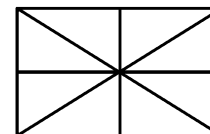
- (i) **Isosceles triangle** : 1 line of symmetry (only along its vertical axis)



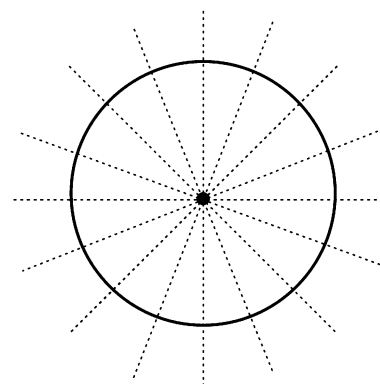
- (ii) **Equilateral triangle** : 3 line of symmetry (through each vertex and midpoint of opposite side)



- (iii) **Square** : 4 line of symmetry (Vertical, Horizontal and two diagonal lines)



- (iv) **Circle** : Infinite lines of symmetry (any line passing through its center)



Increasing Sequence :

Isosceles Triangle $\longrightarrow$ Equilateral Triangle $\longrightarrow$ Square $\longrightarrow$ Circle

Hence, the correct option is (B).

3.162 (C)

Given : A 4×4 digital image has pixel intensities (u) as shown in the figure below,

0	1	0	2
4	7	3	3
5	5	4	4
6	7	3	2

We need to count the number of pixels where the pixel intensity $U \in 4$

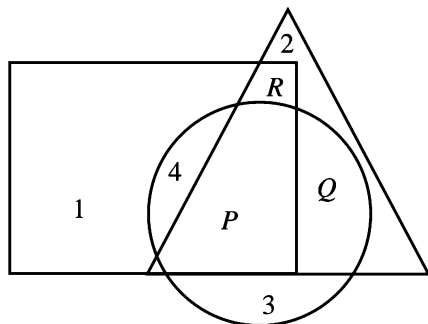
- Row 1 : 0, 1, 0, 2 = 4 pixels (all ≤ 4)
- Row 2 : 4, 7, 3, 3 = 3 pixels (3 pixels 4, 3, 3)

- Row 3 : 5, 5, 4, 4 = 2 pixels (4, 4)
 - Row 4 : 6, 7, 3, 2 = 2 pixels (3, 2)
- Thus, the total number of pixels satisfying $U \leq 4$
- $$4 + 3 + 2 + 2 = 11$$

Hence, the correct option is (C).

3.163 (B)

In the given figure, the number associated with the rectangle triangle and ellipse are 1, 2 and 1 respectively.



From figure :

- (i) P (Inside the ellipse and rectangle)
- The number associated with the rectangle is 1.
 - The number associated with the ellipse is 3.
 - The sum of these two numbers.
 $P = 1 + 3 = 4$
- (ii) Q (Inside the ellipse and triangle)
- The number of associated with the ellipse is 3.
 - The number associated with the triangle is 2.
 - The sum of these two numbers
 $Q = 3 + 2 = 5$
- (iii) R (Inside all three shapes)
- The number associated with the rectangle is 1.
 - The number associated with the triangle is 2.
 - The number associated with the ellipse is 3.

- The sum of these three numbers
 $R = 1 + 2 + 3 = 6$

Hence, the correct option is (B).

3.164 (B)

Given : Length of rectangle = L

Width of rectangle = W

Width of rectangle is increased by 10%.

New width of rectangle = $W + 10\%$ of W
 $= W + 0.1W = 1.1W$

From checking option :

From option (A) :

Old perimeter of rectangle = $2(L + W) = P$

New perimeter of rectangle = $2(L + 1.1W)$
 $= 2(L + W + 0.1W)$
 $= 2(L + W) + 0.2W = P + 0.2W$

Perimeter is increased by 20% of width.

So, option (A) is not correct.

From option (B) :

Old length of diagonal = $\sqrt{L^2 + W^2} = D$

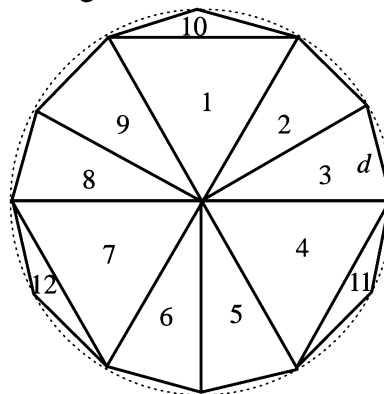
New length of diagonal = $\sqrt{L^2 + (1.1W)^2}$
 $= \sqrt{L^2 + 1.21W^2}$
 $= \sqrt{L^2 + W^2 + 0.21W^2}$

So, option (B) is not correct.

Hence, the correct option is (B).

3.165 (C)

Given : A regular dodecagon (12-sided regular polygon) is inscribed in a circle of radius γ cm as shown is the figure below.



1. A regular dodecagon consists of 12 identical isosceles triangles, each originating from the centre.
2. A square can be formed using multiple isosceles triangles.
3. Triangles are grouped together to form a square of side γ cm.
4. Bases on Standard geometric properties of a dodecagon, the minimum number of triangles required to form a square can be determined.

From dodecagonal symmetry :

- 3 squares can be formed.
- Each Square requires 3 triangles.

Hence, the correct option is (C).

3.166 (C)

Given : Real variable x satisfies :

$$3^{x^2} = 27 \times 9^x$$

$$3^{x^2} = 3^3 \times (3^2)^x$$

$$3^{x^2} = 3^3 \times (3)^{2x} \quad [a^m \times a^n = a^{m+n}]$$

$$3^{x^2} = 3^{3+2x}$$

Comparing power both side,

$$x^2 = 3 + 2x$$

$$x^2 - 2x - 3 = 0$$

$$x^2 - 3x + x - 3 = 0$$

$$x(x-3) + 1(x-3) = 0$$

$$(x+1)(x-3) = 0$$

$$x = -1$$

$$x = 3$$

The value of $\frac{2^{x^2}}{(2^x)^2}$

For $x = -1$,

$$= \frac{2^{(-1)^2}}{(2^{-1})^2} = \frac{2^1}{2^{-2}} = 2^1 \times 2^2 = 2^3$$

For $x = 3$,

$$= \frac{2^{(3)^2}}{(2^3)^2} = \frac{2^3}{2^6} = 2^{3-6} = 2^{-3}$$

Hence, the correct option is (C).

3.167 (A)

(S₁) : Highest score = 100

(S₂) : Fourth highest score = 76

So, the maximum difference among these four students is

$$100 - 76 = 24$$

Since, $24 \leq 25$, these four students are within 25 marks of each other.

Hence, the correct option is (A).

3.168 (B)

The Statement : "For each student, there exists another student in the class such that their scores are at most ten marks away."

To find which statement is necessarily true if the above is false, we need to find the logical negation of the original statement.

1. **Analyze the logical structure :**

$\forall$ student A, $\exists$ another student such that $|\text{Score}_A - \text{Score}_B| \leq 10$.

2. **Negate the statement :**

The negation of "For all X, there exists Y is "There exists X such that for all Y."

3. **Apply negation to the condition :**

The negation of "at most 10 marks away" is "more than 10 marks away".

4. **Resulting Statement :**

"There exists at least one student in the class for whom the scores of all the other students are more than 10 marks away."

Hence, the correct option is (B).

3.169 (C)

From Match 1 and Match 3.

P and X are together so P is not child of X.

R and X are together so R is not child of X.

Therefore, Q must be child of X .

Since, exactly one child has no parent playing and X already has Q as child, Y must be parent of either P or R .

Hence, the correct option is (C).

3.170 (C)

$$AB = r_1 = 2.5, AC = r_2 = 3.5$$

$$AD = r_3 = 5.5, AE = r_4 = 7.5$$

$$AF = r_5 = 10.5, AG = r_6 = 13.5$$

$$L = L_1 + L_2 + L_3$$

$$= \pi r_1^2 + \pi(r_3^2 - r_2^2) + \pi(r_5^2 - r_4^2)$$

$$= \pi(2.5)^2 + \pi(5.5^2 - 3.5^2) + \pi(10.5^2 - 7.5^2)$$

$$= 78.25\pi$$

$$W = W_1 + W_2 + W_3$$

$$= \pi(r_2^2 - r_1^2) + \pi(r_4^2 - r_3^2) + \pi(r_6^2 - r_5^2)$$

$$= \pi(3.5^2 - 2.5^2) + \pi(7.5^2 - 5.5^2)$$

$$+ \pi(13.5^2 - 10.5^2) = 104\pi$$

$$\frac{L}{W} = \frac{78.25\pi}{104\pi} = 0.75$$

Hence, the correct option is (C).

1.171 (D)

Given : The complete figure must contain exactly three continuous intersecting line segments passing through the missing rectangle WXYZ.

Observe the line portions outside the rectangle :

- One line enters from the top-left side and exits at the bottom-right near y .
So inside the rectangle, it must be a downward slanting line from near w to y .
- Another line enters from the bottom-left near z and exits from the top side near x .
So inside, it must be an upward slanting line from z toward x .
- The third line enters from the left side and exits from the right side.

Hence, inside the rectangle, it must be almost horizontal with slight upward slope.

Among the options :

P : has extra wrong connections.

Q : does not give the required downward slanting line.

R : the line connections do not match the external segments.

S : correctly continues all three line segments.

Therefore, the missing portion is S

Hence, the correct option is (D).

3.172 (C)

Given statement:

If Anish scored 100 runs today, he would have been made captain and become the youngest captain in the team's history.

But :

He got out without scoring runs

So captaincy remains unchanged

Now check options.

- (A) Anish made hundred runs
False — he scored zero.
- (B) Anish was captain before the game
Not mentioned
- (C) Current captain is older than Anish
True — because if Anish became captain he would be youngest.
- (D) Anish is youngest player
Not stated.

Hence the correct option is (C).

3.173 (B)

The question asks for 45° clockwise rotation of the given pattern.

Observation:

After 45° rotation the square pattern becomes diamond-shaped.

Check orientation of the small arms in the pattern.

Comparing options:

P → arm orientation mismatches.

Q → perfectly matches rotated orientation.

R and **S** → some segments flipped.

Thus, the correctly rotated figure is **Q**.

Hence, the correct option is (B).

3.174 (B)

Given : PQ is the diameter of the circle and

$$\angle ROS = 80^\circ.$$

The central angle equals the arc it subtends, therefore

$$\text{Arc } RS = 80^\circ \text{ Since } PQ \text{ is a diameter,}$$

$$\text{Arc } RQ = 180^\circ$$

Lines PR and QS are extended to meet at T . The angle formed by two secants outside a circle equals half the difference of the intercepted arcs.

$$\angle RTS = \frac{1}{2}(\text{Arc } PQ - \text{Arc } RS)$$

$$= \frac{1}{2}(180^\circ - 80^\circ)$$

$$= \frac{1}{2}(100^\circ)$$

$$= 50^\circ$$

$$\angle RTS = 50^\circ$$

Hence, the correct option is (B).

3.175 (A)

No. of sides = 3

$$3! = 6$$

No. of sides = 4

$$4! = 24$$

No. of sides = 5! = 120

$$\text{No. of sides} = 6! = 720$$

Hence, the correct option is (A)

3.176 (B)**Step by Step simulation**

Using 1 for ON (white) and 0 for OFF (black) :

Step	Configuration (B_1 to B_7)	Total
------	----------------------------------	-------

		ON
Initial	0 0 0 1 0 0 0	1
Step 1	0 0 1 1 1 0 0	3
Step 2	0 1 1 0 1 1 0	4
Step 3	1 1 0 0 0 1 1	4
Step 4	1 0 1 0 1 0 1	4

Step 4 → 5:

- $B_2(\text{ON}) : B_1 = 1, B_3 = 1$. Both ON ? Yes, → Turn OFF
- $B_6(\text{ON}) : B_5 = 1, B_7 = 1$. Both ON ? Yes. → Turn OFF
- Step 5 Result : 1 0 1 0 1 0 1

Step 5 → 6 : Every OFF bulb has either zero or two ON neighbors. Every ON Bulb has On neighbors. No rules trigger. The state is locked.

The configuration 1 0 1 0 1 0 1 remains unchanged from step 5 onwards. Therefore, at the end of step 8, the number of bulb which are ON is 4.

Hence, the correct option is (B).

3.177 (C)

Sequence of tiles shows number of dots increasing.

Pattern :

$$0 \rightarrow 1 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 5 \rightarrow ?$$

Next number of dots = 6

Among the options, the tile with eight dots is Option (C).

Hence, the correct option is (C).

3.178 (B)

Paper is folded to form a cube.

Shaded regions appear on the outer surface.

From the cube net :

- (i) The top face has stripes

- (ii) One side face has a shaded square
 (iii) Opposite faces cannot appear together.

Checking cubes in Panel II:

Cube (i) violates the adjacency of faces from the net.

Cube (ii) matches the face positions after folding.

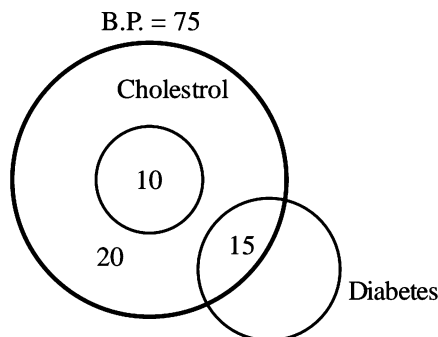
Therefore, only (ii) is possible.

Hence, the correct option is (B).

3.179 (B)

The below Venn Diagram represents the information given :-

Total = 75



Hence, the correct option is (B).

3.180 (C)

From the combined observations of P and R, we have :

R (Youngest so far) < P < S (Oldest so far)

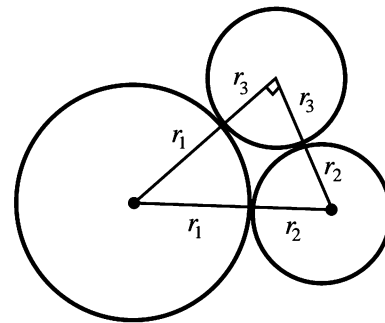
Now, we must place Q. Since there are four people and O cannot be the youngest or the oldest :

- O cannot be younger than R (because then R wouldn't be the youngest).
- O cannot be older than S (because then S wouldn't be the oldest).
- Therefore, O must fit somewhere in the middle (between R and S).

Regardless of exactly where O sits between R and S, the position of R as the person with no one younger than them remains unchanged.

Hence, the correct option is (C).

3.181 (A)



$$(r_1 + r_3)^2 + (r_2 + r_3)^2 = (r_1 + r_2)^2$$

$$(2 + r_3)^2 + (1 + r_3)^2 = (3)^2$$

$$4 + r_3^2 + 4r_3 + 1 + r_3^2 + 2r_3 = 9$$

$$2r_3^2 + 6r_3 + 5 = 9$$

$$2r_3^2 + 6r_3 - 4 = 0$$

$$r_3^2 + 3r_3 - 2 = 0$$

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$a = 1, b = 3, c = -2$$

$$r_3 = \frac{-3 \pm \sqrt{9 - 4(1)(-2)}}{2(1)}$$

$$r_3 = \frac{-3 \pm \sqrt{17}}{2}$$

$$r_3 = \frac{-3 + \sqrt{17}}{2}$$

Hence, the correct option is (A).

3.182 (B)

Each dot = junction

Each line = walkway

A guard placed at a junction can watch all walkways connected to that junction.

The minimum number of guards required so that every walkway has at least one guard at its end corresponds to the minimum vertex cover of the graph.

From the figure, placing guards at three junctions covers all walkways.

Thus minimum guards = 3

Hence, the correct option is (B).

3.183 (A)

- Moving down
 Δ Moving down

Hence, the correct option is (A).

3.184 (D)

- (A) All the mangoes in the basket are not good: This is a "Universal Negative" statement. While it could be true if the original is false, it is not necessarily true. Maybe only one mango is bad.
- (B) No mango in the basket is good: Similar to option (a), this is too extreme. It is a possible scenario, but not a logical necessity.
- (C) In the basket, some of the mangoes are good and some are not good : This assumes at least some are still good. However, if the original statement is false, it's possible that none of them are good. Therefore, this is not necessarily true.
- (D) There exists at least one mango in the basket that is not good: This is the exact logical negation. If it is false that "All are good," then the only thing we know for certain is that "Some (at least one) are not good."

The rule of negation

In logic, the negation of "All" is "Some.....not"

- **Statement :** $\forall x, P(x)$ (For all x , x is P)
- **Negation :** $\exists x, \neg P(x)$ (There exists an x such that x is not P)

Hence, the correct option is (D).

3.185 (C)

- (A) (S1) and (S2) together imply (S3) :
- If the sum is 100 (S1) and the maximum any number can be is 40 (S2), what is the smallest possible value for one of the numbers?
 - To make one number as small as possible, we must make the other three as large as possible (40 each).
 $a + 40 + 40 + 40 = 100$
 $\rightarrow a + 120 = 100 \rightarrow a = -20$
 - Since a number can be less than 20 (it can even be negative here), (S1) and (S2) do not necessarily imply (S3).
- (B) (S2) and (S3) together imply (S1) :
- If each number is between 20 and 40, the average could be anything between 20 and 40.
Example : 21, 21, 21, 21. The average is 21, not 25.
 - Thus, (S2) and (S3) do not imply (S1).
- (C) (S1) and (S3) together imply (S2) :
- The sum is 100 (S1) and each number is at least 20 (S3).
 - To make one number as large as possible, we must make the other three as small as possible (20 each).
 $a + 20 + 20 + 20 = 100$
 $a + 60 = 100$
 $a = 40$
 - Since the largest any number can possibly be is 40, every number must be "at most 40."
 - This matches (S2) perfectly. Therefore, (S1) and (S3) necessarily imply (S2).
- (D) (S1) implies (S3) :
- If the average is 25, the numbers could be 100, 0, 0, 0.

- Here, 0 is not ≥ 20 . So (S1) alone does not imply (S3).

Hence, the correct option is (C).

3.186 (B)

1. Analyze the Constraints

- **Sibling Pairs** : (Meritorius, Brother) and (Son, Daughter).
- **Constraint (i)** : Daughter and Brother share a column.
- **Constraint (ii)** : Son is diagonal to the sibling of the worst orator.
- **Constraint (iii)** : Best and Worst are in the same row.

2. Logical deduction :

Let's assume the Brother is the sibling mentioned in Constraint (ii). This makes Meritorius the worst orator.

- **Placement** : If Son is at (Row 1, Column 2), then the Brother must be at (Row 2, Column 1) to be diagonal.
- **Column Match** : Per Constraint (i), the Daughter must be in the same column as the Brother, placing her at (Row 1, Column 1).
- **Remaining Spot** : This leaves Meritorius at (Row 2, Column 2).

3. Verification :

- **Row 2** : Contains Meritorius and Brother.
- **Row 1** : Contains Daughter and Son.
- **Consistency** : Constraint (iii) says the Best and Worst are in the same row. If Meritorius is the Worst, then the only other person in his row is the Brother.

Hence, the correct option is (B).

3.187 (B)

Given : One of the patterns P, Q, R and S is repeated to obtain the figure shown at the top.

Observe the top figure carefully :

- The pattern repeats horizontally without rotation.
- Hence, the left boundary of one block must match the right boundary of the next block.

Now compare the side boundaries of the options:

- In P, the right edge does not match the left edge when repeated.
- In R, the top-left projection pattern is different from the repeated figure.
- In S, the lower-left portion does not continue correctly in the repeated arrangement.
- In Q, the left and right edges fit perfectly when the block is placed repeatedly side by side, producing exactly the top pattern.

Therefore,

Required pattern = Q

Hence, the correct option is (B).

3.188 (C)

Step 1 : Analyze Figure (i) - Initial State

- **String P** : It is a straight line segment. Its initial length is l .
- **String K** : It is a semicircular arc with P as its diameter.
- Radius of this semicircle = $l/2$
- Length of semicircular arc $K = \pi \times$ (radius) = $\frac{\pi l}{2}$.

Step 2 : Analyze Figure (ii) - After Shortening

Both strings are shortened by length x .

- New length of $P(P')$: $l - x$

- New length of $K(K')$: $\frac{\pi l}{2} - x$

According to Figure (ii), the shortened string K forms a full circle where the shortened string P is the diameter.

- The diameter of this new circle $= l - x$.
- The circumference of this new circle must equal the length of the shortened string K .

Step 3 : Set up the Equation

The formula for circumference is $C = \pi \times$ diameter.

Length of $K' = \pi \times (\text{Length of } P')$

$$\frac{\pi l}{2} - x = \pi(l - x)$$

Now solve for x in terms of l :

$$\frac{\pi l}{2} - x = \pi l - \pi x$$

$$\pi x - x = \pi l - \frac{\pi l}{2}$$

$$x(\pi - 1) = \frac{\pi l}{2}$$

Step 4 : Find the ratio $\frac{x}{l}$

Rearrange the equation to isolate $\frac{x}{l}$:

$$\frac{x}{l} = \frac{\pi}{2(\pi - 1)}$$

Hence, the correct option is (C).

3.189 (C)

Therefore, the total number of tiles = 15.

15 is not divisible by 4.

Since each given piece covers exactly 4 tiles, we can never form a pattern with exactly 15 tiles.

Hence, the correct option is (C).

3.190 (A)

Neeraj's gold-winning throw was in round 2, meaning no one else's best throw occurred in rounds 1 or 2.

After four rounds, Vesely was in second position and didn't improve later, so his best throw had to be in one of the first four rounds.

In round 4, the best throw belonged to Jakub, meaning Vesely's best was not in round 4.

Therefore, Vesely's best throw must have occurred in round 3.

Hence, the correct option is (A).

3.191 (B)

Given sequence of number of dots in tiles :

1st tile $\rightarrow$ 2 dots

2nd tile $\rightarrow$ 3 dots

3rd tile $\rightarrow$?

4th tile $\rightarrow$ 5 dots

5th tile $\rightarrow$ 8 dots

Observe that the numbers follow the Fibonacci pattern :

2, 3, 5, 8

So, the missing tile must contain :

$2 + 3 = 5$ dots

Among the given options, only option (B) has 5 dots.

Therefore,

Hence, the correct option is (B).

3.192 (A)

(A) There are at least 10 students who belong to the same standard.

- According to the Pigeonhole Principle, if you distribute n items into m containers, at least one container must contain $\lceil n/m \rceil$ items.

- Here, $\lceil 100/10 \rceil = 10$.

- This means there must be at least one standard that has 10 or more students. If every standard had fewer than 10 students (i.e., 9 students max), the total would only be $9 \times 10 = 90$, which contradicts the fact that there are 100 students.
 - This statement is always correct.
- (B) There is at least one student in each standard.
- This is not necessarily true. It is possible for one standard to have 100 students and the other nine to have 0 students.
- (C) There are at most 10 students in 10th standard.
- This is not necessarily true. As mentioned above, a single standard (like the 10th) could potentially have all 100 students.
- (D) The total number of students from 1st to 5th standards is at least 50.
- This is not necessarily true. All 100 students could be in the 6th to 10th standards, leaving 0 students in the 1st to 5th.

Hence, the correct option is (A).

3.193 (A)

3.194 (D)

Let's try to color the cube with the minimum number of colors possible :

1. **Start with Corner 'a' :** Give it Color 1.
2. **Move to Neighbors :** Corners connected to 'a' are b, c, and e. According to the rule, they must be different from 'a'. Let's give them Color 2.
 - **Check :** None of these (b, c, e) are connected to each other directly by an edge. They only share a common

neighbor 'a'. So, they can all safely be Color 2.

3. **Move to the next set :** Now look at corner 'd'.
 - 'd' is connected to b and c (which are Color 2).
 - Therefore, 'd' can be Color 1 (the same as 'a').
4. **Complete the Bottom Face:**
 - **Corner 'f' :** Connected to c (Color 2) and e (Color 2). It can be Color 1.
 - **Corner 'h' :** Connected to b (Color 2) and e (Color 2). It can be Color 1.
 - **Corner 'g' :** Connected to d (Color 1), f (Color 1), and h (Color 1). It must be Color 2.

By following this logic, we have assigned colors as follows :

- **Color 1 :** {a, d, f, h}
- **Color 2 :** {b, c, e, g}

Hence, the correct option is (D).

3.195 (C)

1. **Identify the Coordinates**

Let's place the square on a coordinate plane with the bottom-left corner W at $(0, 0)$.

- The square $VWXY$ has a side length of 4 cm.
- The center O_1 of the smaller circle C_1 is at (r_1, r_1) . Since $r_1 = 1$, $O_1 = (1, 1)$.
- The center O_2 of the larger circle C_2 is at $(4 - r_2, 4 - r_2)$ because it touches the top and right sides of the square.

2. **Use the Distance Between Centers**

Since the two circles touch each other at point T , the distance between their

centers O_1 and O_2 is equal to the sum of their radii $(r_1 + r_2)$.

$$\text{Distance } O_1O_2 = r_1 + r_2 = 1 + r_2$$

Using the distance formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$(1 + r_2)^2 = ((4 - r_2) - 1)^2 + ((4 - r_2) - 1)^2$$

$$(1 + r_2)^2 = (3 - r_2)^2 + (3 - r_2)^2$$

$$(1 + r_2)^2 = 2(3 - r_2)^2$$

3. Solve the Equation

Take the square root of both sides :

$$1 + r_2 = \sqrt{2}(3 - r_2)$$

$$1 + r_2 = 3\sqrt{2} - \sqrt{2}r_2$$

Now, group the r_2 terms together :

$$r_2 + \sqrt{2}r_2 = 3\sqrt{2} - 1$$

$$r_2(1 + \sqrt{2}) = 3\sqrt{2} - 1$$

$$r_2 = \frac{3\sqrt{2} - 1}{\sqrt{2} + 1}$$

To rationalize the denominator, multiply by $(\sqrt{2} - 1)$:

$$r_2 = \frac{(3\sqrt{2} - 1)(\sqrt{2} - 1)}{(\sqrt{2} + 1)(\sqrt{2} - 1)}$$

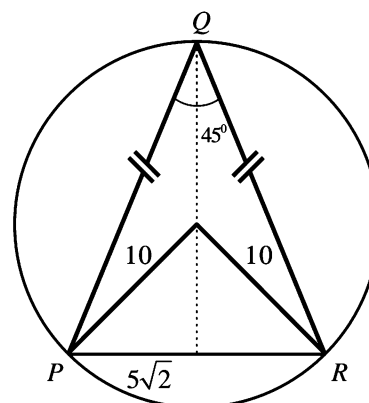
$$r_2 = \frac{(3 \times 2) - 3\sqrt{2} - \sqrt{2} + 1}{2 - 1}$$

$$r_2 = \frac{6 - 4\sqrt{2} + 1}{1}$$

$$r_2 = 7 - 4\sqrt{2}$$

Hence, the correct option is (C).

3.196 (C)



$$PR = 10\sqrt{2}$$

$$OS = 5\sqrt{2}$$

Area of ΔPQR

$$= \frac{1}{2} (10\sqrt{2}) \times (10 + 5\sqrt{2})$$

$$= 50[\sqrt{2} + 1]$$

$$\text{Area of } \Delta OPR = \frac{1}{2} \times 10\sqrt{2} \times 5\sqrt{2}$$

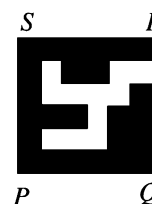
$$= 50$$

$$\text{Shaded} = \Delta PQR - \Delta OPR = 50[\sqrt{2} + 1] - 50$$

$$= 50\sqrt{2}$$

Hence, the correct option is (C).

3.197 (C)



Hence, the correct option is (C).

3.198 (A)

Given : A 3×3 arrangement is formed using dot-pattern tiles. The two missing tiles are in the third column.

Observe the pattern column-wise :

- In each column, the number of black dots in the left vertical strip increases or decreases regularly.
- Also, the lower tile of the missing pair must continue the same pattern seen in the first two columns.

For the third column :

The upper missing tile should have :

- Left column : 2 white + 1 black
- Remaining dots : all black

The lower missing tile should have :

- Left column : 1 white + 3 black
- Remaining dots : all black

Only option (i) matches both these required tiles.

Hence, the correct option is (A).

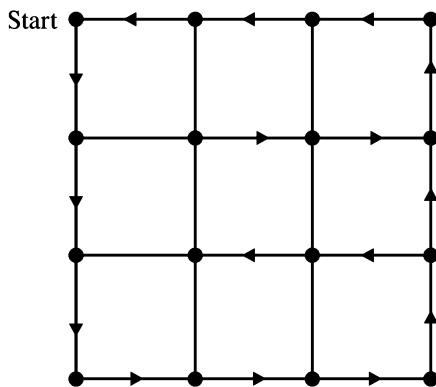
3.199 (A)

Figure (i) is a Hamiltonian cycle.

She must, start at a city, visit every other city exactly once, return to the starting city.

A rectangular grid with at least 2 rows and 2 columns always has Hamiltonian cycle.

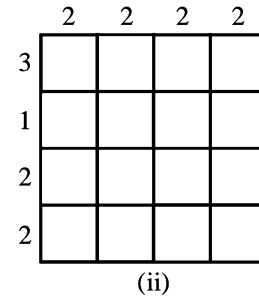
Figure (ii) such a trip is possible for (i), but not for (ii).



Hence, the correct option is (A).

3.200 (B)

All conditions satisfied.



Hence, the correct option is (B).

Engineering Services Examination (ESE)

1. (C)

Given : Diameter of circle $A = 4$ cm.

Diameter of circle $B = 5$ cm.

Circumference of circle $C =$

circumference of A + circumference of B

Thus, $2\pi \times \text{Radius} = 4\pi + 5\pi = 9\pi$

Radius of circle, $C = \frac{9\pi}{2\pi} = 4.5$

Since, Area of circle $= \pi r^2$

Thus, area of circle, $C = \pi \times (4.5)^2 = 20.25\pi$

Similarly, Area of circle $A = 4\pi$

Area of circle $B = 6.25\pi$

Thus, the ratio of area of circle 'C' to the area of circle 'A' and the area of circle 'C' to the area of circle 'B' :

$$= \left(\frac{20.25\pi}{4\pi} \right) \& \left(\frac{20.25\pi}{6.25\pi} \right) \\ = 5.0625 \& 3.24$$

Thus, the ratio is 5.0625 and 3.24.

Hence, the correct option is (C).

2. (B)**Given :** Perimeter of a Rectangular wall = 72 m

Since, Perimeter of a Rectangular wall

$$= 2(L + B)$$

Therefore, $2(L + B) = 72\text{m}$

$$L + B = 36\text{m} \quad \dots(i)$$

Length of Diagonal = 18 m

$$\sqrt{L^2 + B^2} = 18\text{m}$$

$$L^2 + B^2 = 324\text{m}^2$$

By squaring equation (i) we get,

$$(L + B)^2 = 1296\text{m}^2$$

$$L^2 + B^2 + 2LB = 1296\text{m}^2$$

$$2LB = (1296 - 324)\text{m}^2$$

$$2LB = 972\text{m}^2$$

$$LB = 486\text{m}^2$$

Thus, the area of the wall is 486m^2 .

Hence, the correct option is (B).

3. (A)**Given :**Length of the Room, $L = 15\text{ m}$ Width of the Room, $W = 10\text{ m}$

According to the question,

Sum of the areas of the Floor and Ceiling

= Sum of the areas of the four walls.

$$\text{So, } 2 \times LW = 2WH + 2LH$$

$$\begin{aligned} 2 \times 15 \times 10 &= 2 \times 10 \times H + 2 \times 15 \times H \\ &= 50 \times H \end{aligned}$$

$$\text{Height} = 6\text{ m}$$

Since, Volume of cuboidal room

$$= \text{Length} \times \text{Width} \times \text{Height}$$

Thus, Volume of the Room

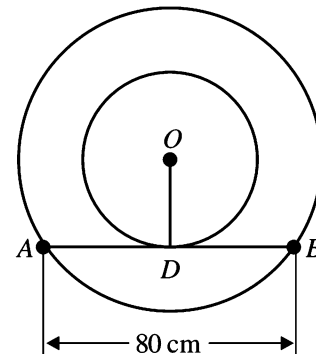
$$= 15 \times 10 \times 6\text{ m}^3 = 900\text{ m}^3$$

Hence, the correct option is (A).

4. (B)

Radius of smaller concentric circle = 9 cm

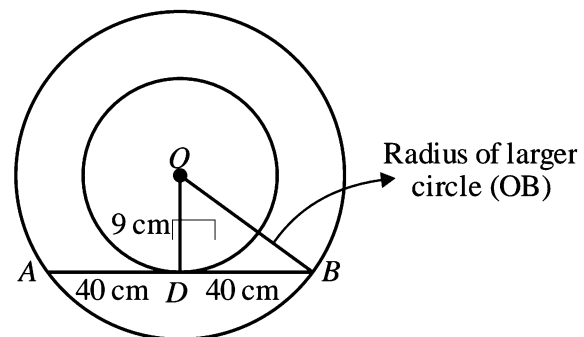
According to the question,



$$AB = 80\text{ cm}$$

$$OD = 9\text{ cm (Radius of smaller circle)}$$

A line segment drawn from center is always perpendicular to that chord and also divides it in two equal parts.

In $\triangle ODB$,

By Pythagoras theorem :

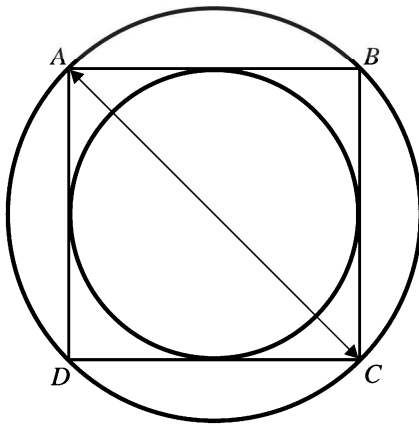
$$\begin{aligned} (OB) &= \sqrt{(OD)^2 + (DB)^2} \\ &= \sqrt{(9)^2 + (40)^2} \\ &= \sqrt{1681} \end{aligned}$$

Thus, $OB = 41\text{ cm}$

Thus, the radius of the larger circle is 41 cm.

Hence, the correct option is (B).

5. (C)

Given :Length of side, $AB = BC$ Diameter of larger circle, $AC = BD$ Thus, $ABCD$ is a square.

As we know,

$$\text{Diagonal} = \sqrt{2} \times \text{side}$$

$$AC = \sqrt{2} \times AB$$

Radius of Larger circle,

$$\frac{AC}{2} = \frac{\sqrt{2} \times AB}{2} = \frac{AB}{\sqrt{2}} \quad \dots(i)$$

Radius of smaller circle,

$$\frac{\text{side}}{2} = \frac{AB}{2} \quad \dots(ii)$$

From equation (i) and (ii),

Area of the larger circle,

$$\pi R^2 = \pi \times \frac{AB}{\sqrt{2}} \times \frac{AB}{\sqrt{2}} = \frac{\pi}{2} AB^2$$

Area of the smaller circle,

$$\pi r^2 = \pi \times \frac{AB}{2} \times \frac{AB}{2} = \frac{\pi}{4} AB^2$$

Thus, the ratio of areas of the large circle to the small circle of a square,

$$\frac{\frac{\pi}{2} \times AB^2}{\frac{\pi}{4} \times AB^2} = 2 : 1$$

Hence, the correct option is (C).

Key Point

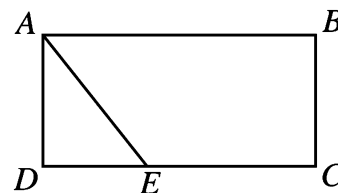
$$\text{Circumradius of a square} = \frac{\text{Side}}{\sqrt{2}}$$

$$\text{In radius of a square} = \frac{\text{Side}}{2}$$

6. (D)

Given : Area of the $\triangle ADE = 20 \text{ cm}^2$

$$\text{Length of side } DE = \frac{1}{3} \times \text{Length of side } DC$$

In $\triangle ADE$,

$$\text{Since, area of triangle} = \frac{\text{Base} \times \text{Height}}{2}$$

$$\text{Thus, area of } \triangle ADE = \frac{AD \times DE}{2}$$

$$2 \times 20 \text{ cm}^2 = AD \times DE = AD \times \frac{DC}{3}$$

$$\text{Thus, } AD \times DC = 120 \text{ cm}^2$$

Since, area of rectangle = Length $\times$ Breadth

$$\text{Area of } ABCD = (AD \times DC) = 120 \text{ cm}^2$$

Hence, the correct option is (D).

7. (B)

Given : Length of four metal rods are

$$= 78 \text{ cm, } 104 \text{ cm, } 117 \text{ cm and } 169 \text{ cm}$$

The maximum possible length (i.e. H.C.F) =

$$\text{HCF of } 78 \text{ cm, } 104 \text{ cm, } 117 \text{ cm and } 169 \text{ cm} \Rightarrow$$

$$78 = 13 \times 2 \times 3$$

$$104 = 13 \times 2 \times 2 \times 2$$

$$117 = 13 \times 3 \times 3$$

$$169 = 13 \times 13$$

Thus, length of common maximum possible rod
= 13 cm

So, the maximum number of pieces that can be cut is,

$$\frac{78 \text{ cm}}{13 \text{ cm}} + \frac{104 \text{ cm}}{13 \text{ cm}} + \frac{117 \text{ cm}}{13 \text{ cm}} + \frac{169 \text{ cm}}{13 \text{ cm}} = 36 \text{ units}$$

Hence, the correct option is (B).

Key Point

The calculation of maximum possible length of rod must be highest common factor of all the values.

8. (B)

Given : The diagonal of the rectangle is $\sqrt{41}$ cm and its area is 20 sq cm.

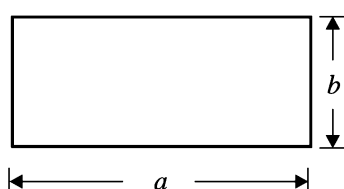
Let the Length be 'a' and breadth be 'b'

According to the Question.

$$a^2 + b^2 = (\sqrt{41})^2 = 41 \quad \dots(i)$$

Area of rectangle.

$$ab = 20 \quad \dots(ii)$$



From Equation (i) and (iii)

$$(a+b)^2 = a^2 + b^2 + 2ab$$

$$(a+b)^2 = 41 + 2(20) = 81$$

$$a+b = 9$$

$$\text{Perimeter} = 2(a+b) = 2 \times 9 = 18 \text{ cm}$$

Hence, the correct option is (B).

9. (B)

Mary (woman) said,

"Only daughter of my father's wife"

So, Mary introduces jack as the son of Mary.

Hence, the correct option is (B).

10. (C)

Given : $A \times B$ means $(A^2 + B^2)$

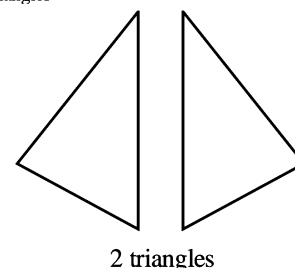
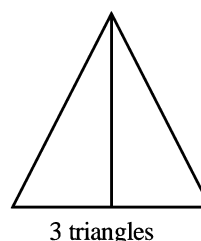
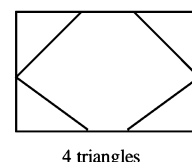
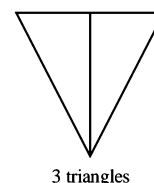
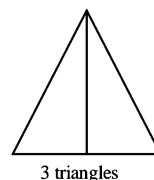
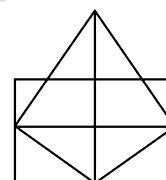
$$4 \times 3 = (4)^2 + (3)^2 = 25$$

$$5 \times (4 \times 3) = 5 \times 25 = (5)^2 + (25)^2$$

$$5 \times (4 \times 3) = 650$$

Hence, the correct option is (C).

11. (C)



$$\text{Total} = 3 + 3 + 4 + 3 + 2 = 15 \text{ triangles}$$

Hence, the correct option is (C).

12. (A)

Given : $\frac{x+1}{x-1} = \frac{a}{b}$ and $\frac{1-y}{1+y} = \frac{b}{a}$

Using Componendo and dividend

$$x = \frac{a+b}{a-b}, y = \frac{a-b}{a+b}$$

$$\begin{aligned} \text{So, } \frac{x-y}{1+xy} &= \frac{\frac{(a+b)}{(a-b)} - \frac{(a-b)}{(a+b)}}{1 + \left(\frac{(a+b)}{(a-b)}\right)\left(\frac{(a-b)}{(a+b)}\right)} \\ &= \frac{(a+b)^2 - (a-b)^2}{2(a^2 - b^2)} \end{aligned}$$

$$\frac{x-y}{1+xy} = \frac{\frac{(a+b)}{(a-b)} - \left(\frac{a-b}{a+b}\right)}{1 + \left(\frac{a+b}{a-b}\right)\left(\frac{a-b}{a+b}\right)}$$

$$\frac{x-y}{1+xy} = \frac{2ab}{a^2 - b^2}$$

Hence, the correct option is (A).

13. (C)

Given : $\frac{2x+3y}{3x+5y} = \frac{18}{29}$

$$\frac{\frac{2x}{y} + 3}{\frac{3x}{y} + 5} = \frac{18}{29}$$

$$\frac{58x}{y} + 87 = \frac{54x}{y} + 90$$

$$\frac{4x}{y} = 3$$

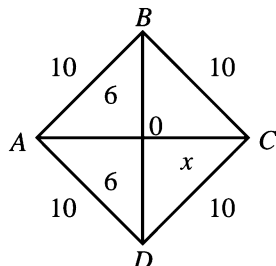
$$\frac{x}{y} = \frac{3}{4}$$

$$x : y = 3 : 4$$

Hence, the correct option is (C).

14. (D)

Given : One side of a rhombus is 10 cm and one of its diagonals is 12 cm.



ABCD is a rhombus in which

$$AB = BC = CD = DA = 10 \text{ cm}$$

$$BD = 12 \text{ cm}$$

$$OB = 6 \text{ cm}$$

[Diagonals of a rhombus bisect each other]

$$(BC)^2 = (OB)^2 + (OC)^2$$

$$(10)^2 = (6)^2 + x^2$$

$$x = OC = 8 \text{ cm}$$

$$AC = 2OC = 16 \text{ cm}$$

$$\text{Area of rhombus} = \frac{1}{2} (\text{the product of diagonals})$$

$$= \frac{1}{2} \times 16 \times 12$$

$$\text{Area of rhombus} = 96 \text{ cm}^2$$

Hence, the correct option is (D).

15. (B)

Let two meet = N^{th} Line

According to the Question

$$\frac{N}{200} = \frac{(817 - N)}{150}$$

$$150N = 817 \times 200 - 200N$$

$$N = \frac{817 \times 200}{350}$$

$$N = 466.85$$

$$N = 467$$

Hence the correct option is (B).

16. *

Given : First the elevator moves up 5 floors down 3 floors and up 2 floors.

Now, elevator is at the 8th floor

$$x + 5 + (-3) + 2 = 8$$

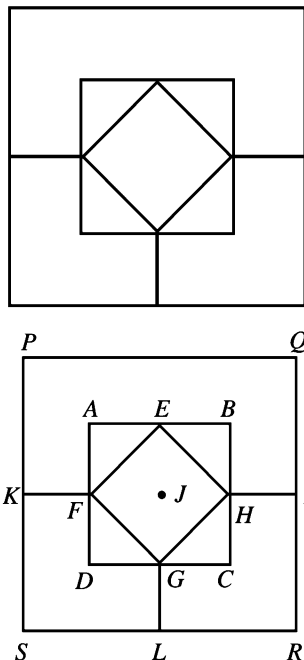
$$x + 2 + 2 = 8$$

$$x = 4$$

‘*’ No option Matched.

17. (B)

Given :



PQRS → 1

ABCD → 2

EFGH → 3

KJLS → 4

IJLR → 5

Hence the correct option is (B).

18. (D)

Let Diophantus total age = x $\therefore$ Son died at $= \frac{x}{2}$

Son's age at the time of Diophantus death

$$= \frac{x}{2} + 4$$

Diophantus age before marriage

$$= x \left(\frac{1}{6} + \frac{1}{12} + \frac{1}{7} \right) = \frac{33x}{84}$$

$$\text{Left age after marriage} = x - \frac{33x}{84} = \frac{51x}{84}$$

Son was born 5 years after marriage

$$\text{Thus, } \frac{x}{2} + 4 + 5 = \frac{51x}{84}$$

$$18x = 1512$$

$$x = 84$$

Hence the correct option is (D).

19. (D)

Given :

$$\sin A = \frac{3}{4}, a = 3 \text{ and } b = 4$$

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

$$\frac{3}{\frac{3}{4}} = \frac{4}{\sin B}$$

$$\sin B = 1 = \sin 90^\circ$$

$$B = 90^\circ$$

Hence, the correct option is (D).

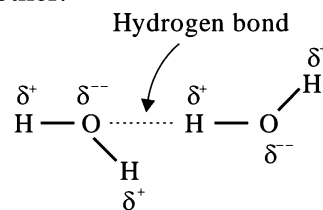
20. (A)

Area of an ellipse = πab $\therefore$ The percentage error = $1 + 1 = 2\%$

Hence, the correct option is (A).

21. (A)

In water molecules (H_2O), the oxygen atom has slightly negative charge due to its higher electronegativity, while the hydrogen atoms have a slightly positive charge. This polarity allows water molecules to form hydrogen bonds with each other.



Hence, the correct option is (A).

22. (B)

Resilience is the capacity of a material to absorb energy when it is deformed elastically and then, upon unloading, to have this energy recovered.

Hence, the correct option is (B).

23. (D)

24. (D)

Targa is a well-known DoS attack tool designed to test system against multiple types of IP-based attacks. It supports various attack methods including malformed packets, that makes it suitable for launching many different kinds of IP-based DoS attacks.

Packet storm refers to traffic overload in general. Teardrop and Nestea are specific attacks.

Hence, the correct option is (D).

25. (*)

26. (*)



4

Seating Arrangement

2011 IIT Madras

- 4.1 L , M and N are waiting in a queue meant for children to enter the zoo. There are 5 children between L and M , and 8 children between M and N . If there are 3 children ahead of N and 21 children behind L , then what is the minimum number of children in the queue? [AE, MN]
- (A) 28 (B) 27
(C) 41 (D) 40

2012 IIT Delhi

- 4.2 Ravi is taller than Arun but shorter than Iqbal. Sam is shorter than Ravi. Mohan is shorter than Arun. Balu is taller than Mohan and Sam. The tallest person can be : [AR, GG, TF]
- (A) Mohan (B) Ravi
(C) Balu (D) Arun

2021 IIT Bombay

- 4.3 Seven cars P , Q , R , S , T , U and V are parked in a row not necessarily in that order. The cars T and U should be parked next to each other. The cars S and V also should be parked next to each other, whereas P and Q can't be parked next to each other. Q and S must be parked next to each other. R is parked to the immediate right of V . T is parked to the left of U . [AG, EE, EY, GG]

Based on the above statements, the only **incorrect** option given below is

- (A) There are two cars parked in between Q and V .
(B) V is the only car parked in between S and R .
(C) Car P is parked at the extreme end.
(D) Q and R are not parked together.
- 4.4 Four persons P , Q , R and S are to be seated in a row, all facing the same direction, but not necessarily in the same order. P and R cannot sit adjacent to each other. S should be seated to the right of Q . Then number of distinct seating arrangements possible is [CE-1, CY, IN]
- (A) 4 (B) 2
(C) 8 (D) 6
- 4.5 Four persons P , Q , R and S are to be seated in row. R should not be seated at the second position from the left end of the row. The number of distinct seating arrangements possible is [AE, AR, BM, CE-2, MN, PH]
- (A) 6 (B) 18
(C) 24 (D) 9
- 4.6 Five persons P , Q , R , S and T are sitting in a row not necessarily in the same order. Q and R are separated by one person, and S should not be seated adjacent to Q . [ME-1, XH]

The number of distinct seating arrangements possible is

- (A) 10 (B) 8
(C) 4 (D) 16

- 4.7** Five person P, Q, R, S and T are to be seated in a row, all facing the same direction, but not necessarily in the same order. P and T cannot be seated at either end of the row. P should not be seated adjacent to S. R is to be seated at the second position from the left end of the row. The number of distinct seating arrangements possible is : [ME-2, MT]

- (A) 2 (B) 4
(C) 3 (D) 5

- 4.8** Six students P, Q, R, S, T and U, with distinct heights, compare their heights and make the following observations.

[CS-2, XE, XL]

Observation I : S is taller than R.

Observation II : Q is the shortest of all.

Observation III : U is taller than only one student.

Observation IV : T is taller than S but is not tallest.

The number of students that are taller than R is the same as number of student shorter than _____.

- (A) T (B) R
(C) S (D) P

2022 IIT Kharagpur

- 4.9** The corners and the mid point of a triangle are name using distinct letters P, Q, R, S, T and U but not necessarily in the same order. Consider the following statements

- The line joining P and R is parallel to the line joining Q and S.

- P is placed on the side opposite to the corner T.
- S and U cannot be placed in the same side.

Which one of the following statements is correct based on the above information?

[CSE]

- (A) P cannot be placed at a corner
(B) U cannot be placed at a midpoint
(C) S cannot be placed at a corner
(D) R cannot be placed at a corner

- 4.10** In a class of five students P, Q, R, S and T, only one student is known to have copied in the exam. The disciplinary committee has investigated the situation and recorded the statements from the students as given below.

Statement of P : R has copied in the exam.

Statement of Q : S has copied in the exam.

Statement of R : P did not copy in the exam.

Statement of S : Only one of us is telling the truth.

Statement of T : R is telling the truth.

The investigating team had authentic information that S never lies.

Based on the information given above, the person who has copied in the exam is

[ECE]

- (A) R (B) P
(C) Q (D) T

- 4.11** Six persons P, Q, R, S, T and U are sitting around a circular table facing the center not necessarily in the same order. Consider the following statements :

- P sits next to S and T.
- Q sits diametrically opposite to P.

- The shortest distance between S and R is equal to the shortest distance between T and U.

Based on the above statements, Q is a neighbor of

[IN, CH, PI]

- (A) P and S (B) U and S
(C) R and T (D) R and U

2023 IIT Kanpur

- 4.12 Three husband-wife pairs are to be seated at a circular table that has six identical chairs. Seating arrangements are defined only by the relative position of the people. How many seating arrangements are possible such that every husband sits next to his wife?

[CE-2]

- (A) 16 (B) 4
(C) 120 (D) 720

2024 IISc Bangalore

- 4.13 P, Q, R, S, and T have launched a new startup. Two of them are siblings. The office of the startup has just three rooms. All of them agree that the siblings should not share the same room.

If S and Q are single children, and the room allocations shown below are acceptable to all.

PR	TS	Q	PQ	RT	S
----	----	---	----	----	---

then, which one of the given options is the siblings ?

- (A) P and T (B) P and S
(C) T and Q (D) T and R

[EC]

- 4.14 Sequence the following sentences (P, Q, R, S) in a coherent passage :

- (P) Shifu's student exclaimed, "Why do you run since the bull is an illusion ?"
(Q) Shifu's said. "Surely my running away from the bull is also an illusion"
(R) Shifu once proclaimed that all life is illusion.
(S) One day, when a bull gave him chase, Shifu began running for his life.

- (A) SPRQ (B) SRPQ
(C) RSPQ (D) RPQS

[EC]

- 4.15 Three distinct sets of indistinguishable twins are to be seated at a circular table that has 8 identical chairs. Unique seating arrangements are defined by the relative positions of the people.

How many unique seating arrangements are possible such that each person is sitting next to their twin?

- (A) 12 (B) 14
(C) 10 (D) 28

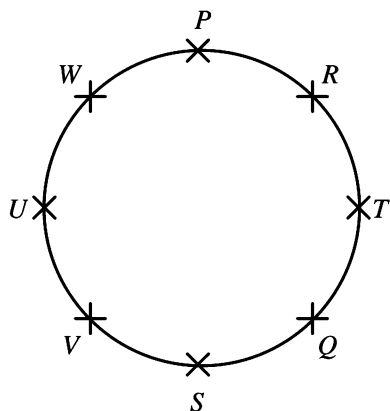
[CE-1, CH]

2025 IIT Roorkee

- 4.16 Eight students (P, Q, R, S, T, U, V, and W) are playing musical chairs. The figure indicates their order of position at the start of the game. They play the game by moving forward in a circle in the clockwise direction.

After the 1st round, 4th student behind P leaves the game. After 2nd round, 5th student behind Q leaves the game. After 3rd round, 3rd student behind V leaves the game. After 4th round, 4th student behind U leaves the game. Who all are left in the game after the 4th round?

(Note : The figure shown is representative.) [ECE]



- (A) P; T; Q; S (B) V; P; T; Q
(C) W; R; Q; V (D) Q; T; V; W

2026 IIT Guwahati

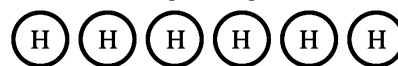
- 4.17** A coin with heads facing up is shown (*H*) and a coin with tails facing up is shown as (*T*).

Six coins are placed in the Starting Arrangement, as shown in the figure below. A "step" is defined as interchanging a pair of adjacent coins without flipping them. The minimum

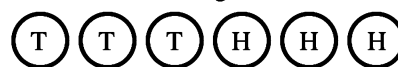
number of steps needed to go from the Starting Arrangement to the Final Arrangement, as shown in the figure, is_____.

[IN, XE]

Starting arrangement



Final arrangement



- (A) 3 (B) 6
(C) 9 (D) 12

Engineering Services Examination (ESE)

1. At the baseball game, Henry was sitting in seat 253. Marla was sitting to the right of Henry in seat 254. In the seat to the left of Henry was George. Inez was sitting to the left of George. Which seat is Inez sitting in?

- (A) 251 (B) 254
(C) 255 (D) 256

[ESE 2022]

Answers	Seating Arrangement
---------	---------------------

4.1	A	4.2	C	4.3	A	4.4	D	4.5	B
4.6	D	4.7	C	4.8	C	4.9	C	4.10	B
4.11	D	4.12	A	4.13	A	4.14	C	4.15	A
4.16	MTA	4.17	C						
Engineering Services Examination (ESE)									
1.	A								

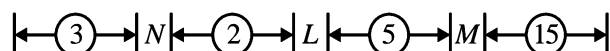
Explanations	Seating Arrangement
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4.1 (A)

Given :

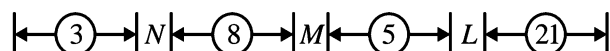
On the basis of positions of L and M there will be two different cases :

Case 1 : If L is seated before M .



Therefore, minimum number of children who can seat in a queue is 28.

Case 2 : If M is seated before L .



Therefore, maximum number of children who can seat in a queue is 40.

Hence, the correct option is (A).

4.2 (C)

Given :

Step 1 : Make proper drafting of given information.

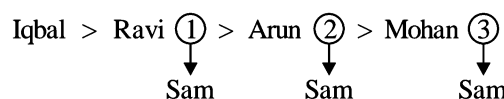
Iqbal > Ravi > Arun

Ravi > Sam

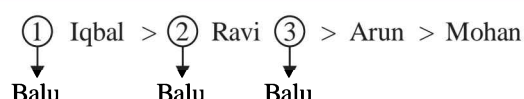
Arun > Mohan

Balu > Mohan & Sam

Step 2 : Make possible arrangements, according to drafted information.



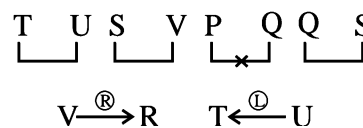
According to this Sam could be seated at '3' positions as relationship between Sam, Arun and Mohan is not specified.



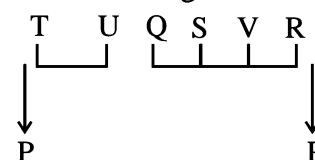
According to this Balu also have '3' possibilities. If we go through option elimination process we can conclude that Balu can be tallest person. Hence, the correct option is (C).

4.3 (A)

Step 1 : Make proper drafting of given info.



Step 2 : Combine drafting :



Only one car is in between Q and V .

Hence, the correct option is (A).

4.4 (D)

Condition 1 : P and R cannot sit adjacent to each other.

Condition 2 : S should be seated to the right of Q .

According to this all possible cases will be

- | | |
|------------|------------|
| 1. Q P S R | 2. Q R S P |
| 3. P Q S R | 4. R Q S P |
| 5. P Q R S | 6. R Q P S |

Thus, there are 6 distinct seating arrangement are possible.

Hence, the correct option is (D).

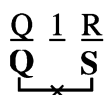
4.5 (B)

Number of arrangements = $3 \times 3! = 18$

Hence, the correct option is (B).

4.6 (D)

Step 1 : Make proper drafting of given information



Step 2 : Possibilities of seating arrangements.

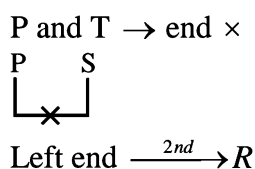
Case 1 :	Q	P	R	S	T
	Q	T	R	S	P
	Q	P	R	T	S
	Q	T	R	P	S
Case 2 :	P	Q	T	R	S
	T	Q	P	R	S
Case 3 :	S	P	Q	T	R
	S	T	Q	P	R
Case 4 :	R	P	Q	T	S
	R	T	Q	P	S
Case 5 :	S	R	P	Q	T
	S	R	T	Q	P
Case 6 :	P	S	R	T	Q
	T	S	R	P	Q
	S	P	R	T	Q
	S	T	R	P	Q

Thus, the number of distinct seating arrangements possible is 16.

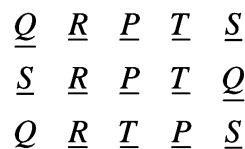
Hence, the correct option is (D).

4.7 (C)

Step 1 : Make proper drafting of given information,



Step 2 : Make possibilities according to drafting,

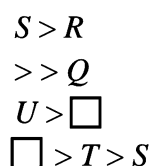


Thus, the number of distinct seating arrangements possible is 3.

Hence, the correct option is (C).

4.8 (C)

Step 1 : Make proper drafting of given information :



Step 2 : Combine all drafted information & make possible case.

- 1- P
- 2- T
- 3- S
- 4- R
- 5- U
- 6- Q

Now, it is clear that the numbers of students taller than R is the same as the numbers of students shorter than S.

Hence, the correct option is (C).

4.9 (C)

Given : The corners and midpoint of a triangle are name using distinct P, Q, R, S, T and U.

The line joining P and R is parallel to the line joining Q and S.

P is placed on the side opposite to the corner T.

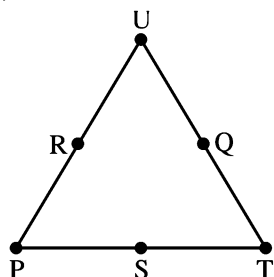
S and U cannot be placed in the same side.

With this given information we can draw multiple diagram which satisfy all the given conditions.

To prove given statement in the options which one is correct, we will draw different diagrams for each option.

According to option (A) :

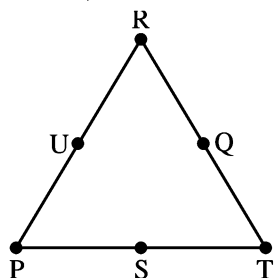
P cannot be placed at a corner but by the figure shown below,



P can be placed at a corner and all the other conditions are also satisfying.

According to option (B) :

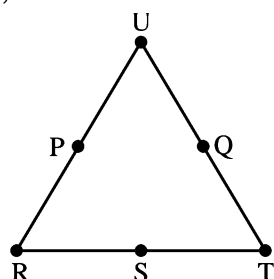
U cannot be placed at a mid point but by the figure shown below,



U can be placed at a midpoint and all the other conditions are also satisfying.

According to option (D) :

R cannot be placed at a corner but by the figure shown below,



R can be placed at a corner and all the other conditions are also satisfying.

According to option (C) :

S cannot be placed at a corner.

By all the possible diagram only that condition is not possible and S can never be placed at a corner.

Hence, the correct option is (C).

4.10 (B)

Given : In a class of five students P, Q, R, S and T only student is known to have copied in the exam.

The recorded statement from students

Statement of P : R has copied in the exam.

Statement of Q : S has copied in the exam.

Statement of R : P did not copy in the exam.

Statement of S : only one of us is telling the truth.

Statement of T : R is telling the truth.

The investigating team have authentic information that S never lies.

S says only one of us is telling the truth.

Hence, statement of all other students will be wrong.

Statement of P : R did not copied in the exam.

Statement of Q : S did not copied in the exam.

Statement of R : P copied in the exam.

Statement of T : P copied in the exam.

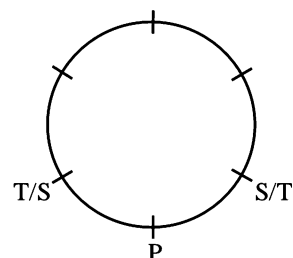
So, P copied in the exam is proved.

Hence, the correct option is (B).

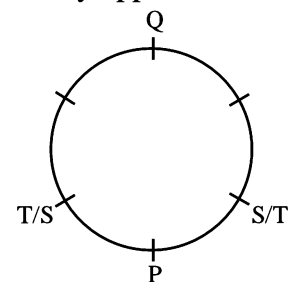
4.11 (D)

Given : Six persons P, Q, R, S, T and U are sitting around a circular table facing the center.

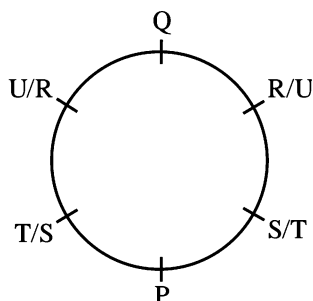
P sits next to S and T



Q sits diametrically opposite to P



The shortest distance between S and R is equal to the shortest distance between T and U.



By the figure shown above
Q is the neighbor of R and U.
Hence, the correct option is (D).

4.12 (A)

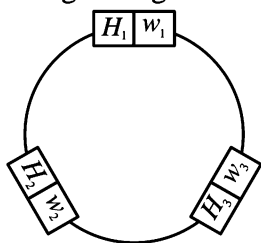
Given : Three husband-wife pairs are to be seated at a circular table that has six identical chairs. Seating arrangements are defined only by the relative position of the people. The number of seating arrangements are possible such that every husband sits next to his wife.

Let us form the pairs of husband wife.

Now these pairs can be arranged circular table in $(3-1)! \text{ ways} = 2 \text{ ways}$.

Their possible internal arrangement is, $2! \times 2! \times 2! = 8$

Hence, total seating arrangement is $2 \times 8 = 16$



Hence, the correct option is (A).

4.13 (A)

Given :

P, Q, R, S and T have launched a new startup and two of them are siblings.

S and Q are single children.

Room allocations of three rooms in the office provided siblings should not share the same rooms is given below.

PR	TS	Q	PQ	RT	S
----	----	---	----	----	---

Checking from the options

- (A) P and T : Since P and T are not single child and are not sharing the same rooms in the room allocation. Hence P and T are siblings.
- (B) P and S : Since S is the single child. P and S are not siblings.
- (D) T and Q : Since Q is the single child. T and Q are not siblings.
- (C) T and R : From the room allocations given in question R and T share the same rooms. Hence, T and R are not siblings.

Hence, the correct option is (A).

4.14 (C)

Given : Sentence P,Q,R,S in a coherent passage.

The above question is based on time sequence.

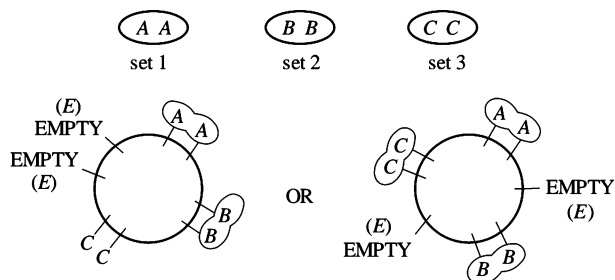
Thus, the sentence should be organized in a chronological order

Sentence	Order
Shifu's student exclaimed, "Why do you run since the ball is an illusion?"	3
Shifu's said "Surely my running away from the bull is also an illusion"	4
Shifu once proclaimed that all life is illusion	1
One day, when a bull gave him chase, Shifu began running for his life	2

This arrangement makes a logical sequence (R, S, P, Q) in clockwise order.

Hence, the correct option is (C).

4.15 (A)



(Set 1) (Set 2) (Set 3) (E E) $\equiv$ Total 5 units

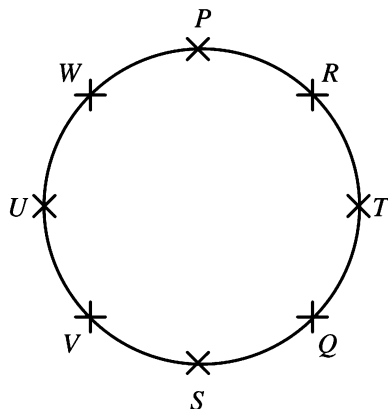
Circular arrangement of 5 units out of which 2 are alike (E and E)

$$= \frac{(5-1)!}{2!} = \frac{4!}{2!} = \frac{4 \times 3 \times 2 \times 1}{2 \times 1} = 12$$

So, number of unique sitting arrangement met Possible = 12

Hence, the correct option is (A).

4.16 (MTA)



First Round Elimination : 4th student behind P

- Behind P means moving counterclockwise.
- 1st : W • 2nd : U
- 3rd : V • 4th : S

S is eliminated

Remaining students :

$P \rightarrow R \rightarrow T \rightarrow Q \rightarrow V \rightarrow U \rightarrow W$

Second Round Elimination : 5th student behind Q.

- Behind P means moving counterclockwise.

- 1st : T
- 2nd : R
- 3rd : P
- 4th : W
- 5th : U

U is eliminated

Remaining students :

$P \rightarrow R \rightarrow T \rightarrow Q \rightarrow V \rightarrow W$

Third Round Elimination : 3rd student behind V

- Behind P means moving counterclockwise.
- 1st : Q
- 2nd : T
- 3rd : R

R is eliminated

Remaining students : $P \rightarrow T \rightarrow Q \rightarrow V \rightarrow W$

Fourth Round Elimination : 4th student behind U.

W is already eliminated.

None of the options match exactly.

4.17 (C)

Starting arrangement

H H H H H H

Final arrangement

T T T H H H

A step means swapping two adjacent coins without flipping them.

To obtain the final arrangement, three coins showing T must move to the left side across three coins showing H.

Each T-H crossing requires one swap.

Number of such crossings:

$$3 \times 3 = 9$$

Hence, the minimum number of steps required = 9

Hence, the correct option is (C).

Engineering Services Examination (ESE)**1. (A)**

According to the Question.

- Henry was sitting in seat 253.
- Marla was sitting to the Right of Henry in seat 254.
- In the seat to the left of Henry was George. Inez was sitting to the left of George.

Inez	George	Henry	Marla
251	252	253	254

Inez is sitting in seat 251.

Hence the correct option is (A).



CHAPTER

3

VERBAL ABILITY

Contents :

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2.	Analogies	3.14 - 3.22
3.	Sentence Completion	3.23 - 3.60
4.	Idioms & Phrases	3.61 - 3.69
5.	Grammar	3.70 - 3.89
6.	Case Studies	3.90 - 3.143

1

Synonyms & Antonyms

2010 IIT Guwahati

- 1.1** Which of the following options is the closest in meaning to the word below?

Circuitous [All branches]

- (A) Cyclic (B) Indirect
(C) Confusing (D) Crooked

- 1.2** Which of the following options is the closest in meaning to the word below?

Ephemeral [TF]

- (A) Effeminate (B) Ghostlike
(C) Soft (D) Short-lived

- 1.3** Which of the following options is the closest in meaning to the word below?

Exhort [MN]

- (A) Urge (B) Condemn
(C) Restrain (D) Scold

2011 IIT Madras

- 1.4** Choose the word from the options given below that is most nearly opposite in meaning to the given word:

Polemical [GG, TF]

- (A) Imitative (B) Conciliatory
(C) Truthful (D) Ideological

- 1.5** Choose the word from the options given below that is most nearly opposite in meaning to the given word:

Deference [AE, MN]

- (A) aversion (B) resignation
(C) suspicion (D) contempt

- 1.6** Choose the word from the options given below that is most nearly opposite in meaning to the given word:

Frequency

[AG, CY, EC, EE, IN, MA, MT, XE, XL]

- (A) Periodicity (B) Rarity
(C) Gradualness (D) Persistency

- 1.7** Choose the word from the options given below that is most nearly opposite in meaning to the given word :

Amalgamate

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) Merge (B) Split
(C) Collect (D) Separate

- 1.8** Which of the following options is the closet in meaning to the word below :

Inexplicable

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) Incomprehensible (B) Indelible
(C) Inextricable (D) Infallible

2012 IIT Delhi

- 1.9** Which one of the following options is the closest in meaning to the word given below?

[CY, EC, EE, IN, MA, MT, XE, XL]

Latitude

- (A) Eligibility
(B) Freedom
(C) Coercion
(D) Meticulousness

1.10 Which one of the following option is the closest in meaning to the word given below? [BT, CE, CH, CS, ME, PH, PI]

Mitigate

- (A) Diminish (B) Divulge
(C) Dedicate (D) Denote

1.11 Which one of the following options is the closest in meaning to the word given below? [AR, GG, TF]

Pacify

- (A) Excite (B) Soothe
(C) Deplete (D) Tire

2013 IIT Bombay

1.12 They were requested not to **quarrel** with others. Which one of the following options is the closest in meaning to the word **quarrel**? [EC, EE, IN]

- (A) Make out (B) Call out
(C) Dig out (D) Fall out

1.13 Which of the following options is the closest in meaning to the word given below [AR, CE, GG, MA, MT, PH, TF]

Primeval

- (A) Modern (B) Historic
(C) Primitive (D) Antique

1.14 Which one of the following option is the closest in meaning to the word given below? [CS, ME, PI]

Nadir

- (A) Highest (B) Lowest
(C) Medium (D) Integration

2014 IIT Kharagpur

1.15 Which of the following option is the closest in meaning to the word underlined in the sentence below?

In a democracy, everybody has the freedom to **disagree** with the government. [EC-4, ME-4]

- (A) dissent (B) descent
(C) decent (D) decadent

1.16 While receiving the award, the scientist said, "I feel vindicated". Which of the following is closest in meaning to the word "Vindicated"? [EC-4, ME-4]

- (A) Punished (B) Substantiated
(C) Appreciated (D) Chastened

1.17 Match the columns. [CS-2, EE-2]

Column 1

1. Eradicate
2. Distort
3. Saturate
4. Utilize

Column 2

- P. Misrepresent
- Q. Soak Completely
- R. Use
- S. Destroy utterly

- (A) 1:S, 2:P, 3:Q, 4:R
(B) 1:P, 2:Q, 3:R, 4:S
(C) 1:Q, 2:R, 3:S, 4:P
(D) 1:S, 2:P, 3:R, 4:Q

1.18 Choose the word that is opposite in meaning to the word "coherent".

[CS-3, EE-3]

- (A) sticky
(B) well-connected
(C) rambling
(D) friendly

1.19 A student is required to demonstrate a high level of **comprehension** of the subject, especially in the social sciences.

The word closest in meaning to **comprehension** is

[AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

- (A) Understanding (B) Meaning
(C) Concentration (D) Stability

2015 IIT Kanpur

- 1.20 Choose the word most similar meaning to the given word :

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]

Educe

- (A) Exert (B) Educate
(C) Extract (D) Extend

- 1.21 Choose the word most similar in meaning to the given word :

Awkward [EC-2, ME-1]

- (A) Inept (B) Graceful
(C) Suitable (D) Dreadful

- 1.22 Which word is not a synonym for the word *vernacular*? [CE-2]

- (A) regional (B) indigeneous
(C) indigent (D) colloquial

- 1.23 The word similar in meaning to 'dreary' is [CE-2]

- (A) cheerful (B) dreamy
(C) hard (D) dismal

2016 IISc Bangalore

- 1.24 The Buddha said, "Holding on to anger is like **grasping** a hot coal with the intent of throwing it at someone else; you are the one who gets burnt."

Select the word below which is closest in meaning to the word underlined above.

[AR, CY, EC-3, IN, MA, PE]

- (A) burning (B) igniting
(C) clutching (D) flinging

2017 IIT Roorkee

- 1.25 Choose the option with words that are not synonyms. [CS-2, EE-2]

- (A) Aversion, dislike
(B) Luminous, radiant
(C) Plunder, loot
(D) Yielding, resistant

- 1.26 There was no doubt that their work was **thorough**.

Which of the words below is closest in meaning to the underlined word above?

[CE-2, IN, XE, XL]

- (A) Pretty (B) Complete
(C) Sloppy (D) Haphazard

2020 IIT Delhi

- 1.27 Select the most appropriate word that can replace the underlined word without changing the meaning of the sentence :

Now-a-days, most children have a tendency to **belittle** the legitimate concerns of their parents. [CE-2]

- (A) disparage (B) begrudge
(C) reduce (D) applaud

2022 IIT Kharagpur

- 1.28 The movie was funny and I _____? [CE-2]

- (A) Could helped laughed
(B) Could help laughing
(C) Couldn't help laughing
(D) Couldn't help laughed

2023 IIT Kanpur

- 1.29 The line ran _____ the page, right through the centre, and divided the page into two.

[CE-2]

- (A) across (B) of
(C) between (D) about

2024 IISc Bangalore

- 1.30** If '→' denotes increasing order of intensity, then the meaning of the words [charm → enamor → bewitch] is analogous to [bored → _____ → weary]. Which one of the given options is appropriate to fill the blank?

(A) jaded (B) baffled
(C) dead (D) worsted

[EC]

- 1.31** If '→' denotes increasing order of intensity, then the meaning of the words [drizzle → rain → downpour] is analogous to [_____ → quarrel → feud]. Which one of the given options is appropriate to fill the blank?

(A) bicker (B) bog
(C) dither (D) dodge

[IN, CE-2]

- 1.32** If '→' denotes increasing order of intensity, then the meaning of the words [simmer → seethe → smolder] is analogous to [break → raze → _____]. Which one of the given options is appropriate to fill the blank?

(A) obfuscate (B) obliterate
(C) fracture (D) fissure

[CE-1, CH]

- 1.33** If '→' denotes increasing order of intensity, then the meaning of the words [smile → giggle → laugh] is analogous to [disapprove → _____ → chide].

Which one of the given options is appropriate to fill the blank?

(A) Reprove (B) Praise
(C) Reprise (D) Grieve

[ME]

- 1.34** If '→' denotes increasing order of intensity, then the meaning of the words [dry → arid → parched] is analogous to [diet → fast → _____]. Which one of the given option is appropriate to fill the blank?

(A) Starve (B) Reject
(C) Feast (D) Deny

[CS-1]

- 1.35** If '→' denotes increasing order of intensity, then the meaning of the words [walk → jog → sprint] is analogous to [bothered → _____ → daunted].

Which one of the given options is appropriate to fill the blank?

(A) Phased (B) Phrased
(C) Fazed (D) Fused

[CS-2]

2025 IIT Roorkee

- 1.36** The CEO's decision to downsize the workforce was considered myopic because it sacrificed long-term stability to accommodate short-term gains.

Select the most appropriate option that can replace the word "myopic" without changing the meaning of the sentence.

[CS-1]

(A) visionary (B) shortsighted
(C) progressive (D) innovative

- 1.37** Courage : Bravery :: Yearning : _____ Select the most appropriate option to complete the analogy.

[PI, DA]

(A) Longing (B) Yelling
(C) Yawning (D) Glaring

2026 IIT Guwahati

1.38 Among the following options, the antonym of the word "nocturnal" is _____. [EC]

- (A) Normal (B) Diurnal
(C) Abnormal (D) Exceptional

1.39 Match the words in Column I with their synonyms in Column II. [EE, PI, CE-1]

Column I		Column II	
(i)	Lonely	(p)	Verbatim
(ii)	Literal	(q)	Solitary
(iii)	Lousy	(r)	Deadly
(iv)	Lethal	(s)	Terrible

- (A) (i)-(q); (ii)-(p); (iii)-(s); (iv)-(r)
(B) (i)-(q); (ii)-(s); (iii)-(r); (iv)-(p)
(C) (i)-(s); (ii)-(p); (iii)-(q); (iv)-(r)
(D) (i)-(r); (ii)-(s); (iii)-(p); (iv)-(q)

Answers Synonyms & Antonyms

1.1	B	1.2	D	1.3	A	1.4	B	1.5	D
1.6	B	1.7	B	1.8	A	1.9	B	1.10	A
1.11	B	1.12	D	1.13	C	1.14	B	1.15	A
1.16	B	1.17	A	1.18	C	1.19	A	1.20	C
1.21	A	1.22	C	1.23	D	1.24	C	1.25	D
1.26	B	1.27	A	1.28	C	1.29	C	1.30	A
1.31	A	1.32	B	1.33	A	1.34	A	1.35	C
1.36	B	1.37	A	1.38	B	1.39	A		

Explanations Synonyms & Antonyms**1.1 (B)**

Circuitous : Deviating from a straight course; indirect.

Cyclic : Recurring in cycle.

Indirect : Not leading by straight line.

Confusing : Lacking clarity.

Crooked : Bent or irregular in shape.

Here, indirect is closest in meaning to circuitous.

Hence, the correct option is (B).

1.2 (D)

Ephemeral : Lasting or used for only a short period of time.

Effeminate : Having feminine qualities untypical of a man.

Ghostlike : Resembling or characteristic of a phantom.

Soft : Pleasing or agreeable to the senses.

Short-lived : Not living or lasting long.

Hence, the correct option is (D).

1.3 (A)

Exhort : To incite by argument or advice; urge strongly.

Urge : To advise or try hard to persuade somebody to do something.

Condemn : To declare to be reprehensible, wrong, or evil usually after weighing evidence and without reservation.

Restrain : To keep somebody or something under control; to prevent somebody or something from doing something.

Scold : To speak angrily to somebody because he/she has done something bad or wrong.

Hence, the correct option is (A).

1.4 (B)

Polemical : A strong verbal or written attack on someone or something.

Imitative : copying or following a model or example.

Conciliatory : Making someone less angry or hostile.

Truthful : Telling or expressing the truth.

Ideological : Relating to or concerned with ideas.

Hence, the correct option is (B).

1.5 (D)

Deference : Polite behavior that you show towards somebody.

Aversion : A strong feeling of not liking somebody/something.

Resignation : An act or instance of resigning something.

Suspicion : An act or instance of suspecting or the state of being suspected.

Contempt : The feeling that somebody / something does not deserve any respect.

Hence, the correct option is (D).

1.6 (B)

Frequency : Means occurring at frequent intervals. So opposite of it, is '**rarity**' which means infrequency of occurrence.

Periodicity : The quality or state of being periodic; recurrence at regular intervals.

Rarity : The quality or state of being rare; infrequency of occurrence.

Gradualness : The quality of change in ascending or descending in a moderate rate.

Persistency : Persistent determination; the quality of being determined to do or achieve something.

Here, rarity is nearly opposite in meaning to frequency.

Hence, the correct option is (B).

1.7 (B)

Amalgamate : Process of merging or combining, blending, collecting or turning into a single mass. The opposite of the word amalgamate are disjoin, disunite, sever, rupture, scatter, split, separate etc.

Split : To divide something into multiple parts.

Separate : Means not connected, apart.

Merge : Process of combining individual elements.

Collect : Means keeping a number of things together.

The most nearly opposite in meaning to amalgamate is **Split** because splitting means turning a single mass into multiple one.

Hence, the correct option is (B).

1.8 (A)

Inexplicable : Something that can not be explained; puzzling, abstruse or unsolvable.

Incomprehensible : Unclear, confusing, puzzled (similar to inexplicable).

Indelible : Something that can not be erased.

Inextricable : Something that can not be separated or released.

Infallible : Incapable of making mistakes or being wrong.

Here, only option (A) is closest in meaning to the word inexplicable.

Hence, the correct option is (A).

1.9 (B)

Latitude : Freedom from normal restraints, limitations or regulations.

Eligibility : The quality or state of being eligible.

Freedom : The condition of being free of restraints.

Coercion : Refer to force.

Meticulousness : Extremely careful and precise.

Hence, the correct option is (B).

1.10 (A)

Mitigate : To reduce or to lessen.

Diminish : Reduced in size or importance.

Divulge : To make something known.

Dedicate : To give all energy or time.

Denote : To represent something.

Diminish is closest in meaning to the word mitigate.

Hence, the correct option is (A).

1.11 (B)

Pacify : To make somebody who is angry or upset be calm or quiet.

Excite : To make somebody react in a particular way.

Soothe : To make somebody calmer or less upset.

Deplete : To reduce the amount of something so that there is not much left.

Tire : To feel that you need to rest or sleep.

Hence, the correct option is (B).

1.12 (D)

Quarrel : disagreement; argument.

Make out : To cause to exist or happen; bring about; to understand.

Call out : To cause to assemble ; summon.

Dig out : To remove ; unearth.

Fall out : To quarrel, brawl, part with, spar.

The closest option is fall out.

Hence, the correct option is (D).

1.13 (C)

Primeval : Earliest time in history.

Modern : Recent times; something of the present time.

Historic : Something that is famous or important in history.

Primitive : Early stage of development in history.

Antique : Very old and valuable.

Its synonyms are Ancient, Prehistoric, antique, primitive and primordial.

But the closest meaning of primeval is primitive because primitive means early stage in the historic development.

Hence, the correct option is (C).

1.14 (B)

Nadir : It means the lowest point which is in opposite to the word Zenith (highest point).

Hence, the correct option is (B).

1.15 (A)

Dissent : To fail to agree, to differ in opinion, to cause discomfort or distress.

Descent : To move downward, lineage, origin.

Decent : Satisfactory, civilized, proper.

Decadent : To decline, retrogressive, tending to fall.

Hence, the correct option is (A).

1.16 (B)

Vindicated : To set free, to free from allegation, confirm, to provide justification.

Substantiated : Means to show to be true, justified, providing evidence.

Appreciated : To recognize how good something or someone is.

Chastened : To bring down.

Here, closest in meaning to the word vindicated is substantiated.

Hence, the correct option is (B).

1.17 (A)

Eradicate : Destroy utterly, root out, uproot, abolish.

Distort : Misrepresent, subvert, warp.

Saturate : Soak completely, fill something so thoroughly that no more can be absorbed.

Utilize : Use, consume, tap, make a good thing.

This indicates that the correct sequence must be S, P, Q and R.

Hence, the correct option is (A).

1.18 (C)

Coherent : clear and easy to understand.

Sticky : Something that attaches itself or stick to things.

Well-connected : Properly joint together.

Friendly : Behaving in pleasant and kind way.

Rambling : Lengthy and confusing.

Rambling is clearly opposite in meaning to coherent.

Hence, the correct option is (C).

1.19 (A)

Comprehension : Ability to understand something.

Hence, the correct option is (A).

1.20 (C)

Educe : Take out or extract.

Exert : Apply a force, influence or quality.

Educate : Give intellectual or moral instruction to.

Extract : Remove with care or effort.

Extend : Make larger or longer.

Hence, the correct option is (C).

1.21 (A)

Awkward : Clumsy, unskilled, inept.

Graceful : A way of moving that is smooth and attractive and is not stiff or awkward.

Suitable : Proper; appropriate.

Dreadful : Very bad or unpleasant.

Hence, the correct option is (A).

1.22 (C)

Vernacular : A form of language spoken by particular group of people or region or country.

Indigenous : Something that naturally exists in a place or country rather than coming from another place.

Indigent : Poor, needy.

Colloquial : Language, word or expression which is familiar, not formal.

Regional : Something that is from a particular region or place.

Except indigent, all other options are synonym of vernacular.

Hence, the correct option is (C).

1.23 (D)

Dreary : Dull, unattractive, nothing of interest.

Cheerful : Excited, joyful

Dreamy : Having qualities such as gorgeous, fabulous, incredible.

Dismal : Sad or without hope, dull.

Hence, the correct option is (D).

1.24 (C)

The underlined word 'grasping' means clutching or holding something tightly.

Burning : Producing flames.

Igniting : Catching fire.

Clutching : Holding something tightly.

Flinging : To throw something suddenly with a lot of force.

Hence, the correct option is (C).

1.25 (D)

Yielding : Tending to give up under pressure.

Resistant : Offer resistance or opposing.

Luminous : Bright or shining.

Radiant : Glowing brightly

Aversion : Strong dislike

Plunder : Rob or steal goods

Loot : Rob, sack

Yielding and resistant are not synonyms.

Hence, the correct option is (D).

1.26 (B)

The underlined word **thorough** means complete with regard to every detail.

Pretty : Attractive, Lovely.

Sloppy : Careless, Negligent.

Haphazard : Unsystematic.

Hence, the correct option is (B).

1.27 (A)

Disparage : To depreciate or to lower in rank or reputation.

Begrudge : Displeasure, disapproval or envy.

Reduce : Decrease or diminish in size, amount, extend or number.

Applaud : To express approval, praise.

Belittle : To speak slightly of.

To depreciate or to seem little or less.

Option (A) is closest in meaning to the word belittle.

Hence, the correct option is (A).

1.28 (C)

In this filler, we are getting sense of uncontrolled laugh because of the funny movie. So, option (C) is grammatically correct.

Hence, the correct option is (C).

1.29 (C)

Given : The line ran **across** the page, right through the centre, and divided the page into two.

Hence, the correct option is (A).

1.30 (A)

Given : [charm → enamor → bewitch]

'→' denotes increasing orders of intensity

[bored → _____ → weary]

charm : A quality that pleases and attracts people

enamor : Be tilted with love for

bewitch : to attract and interest somebody very much

bored : Feeling tired and perhaps slightly annoyed because something is not interesting

weary : Very tired, especially after you have been doing something for a long time

From options

(A) jaded : tired and bored after doing same thing for a long time

(B) baffled : confused or perplexed

(C) dead : no longer alive

(D) worsted : a fine smooth yarn spun from combed long. Staple wool

From the above options and their meaning we see that options (B), (C) and (D) are not appropriate for given analogy and option (A) is logical in the analogy.

Hence, the correct option is (A).

1.31 (A)

Given : [drizzle → rain → downpour]

'→' denote increasing order of intensity

[_____ → quarrel → feud]

Meaning of the given words are

drizzle → to rain in very small drops or very lightly

rain → the drops of water that fall from the sky

downpour → a heavy, sudden fall of rain

quarrel → an angry argument or disagreement

feud → an angry and serious argument between two people or groups that continues over a long period of time.

From options

- (A) bicker : to argue about unimportant things
- (B) bog : an area of ground that is very soft and wet
- (C) dither to be unable to decide something, to hesitate
- (D) dodge : to move quickly in order to avoid

From the above options are there meanings we see that options (B), (C) and (D) are not appropriate for given analogy and option (A) is logical in the analogy.

Hence, the correct option is (A).

1.32 (B)

Given : [simmer → seethe → smolder]

'→' denotes increasing order of intensity

[break → raze →]

Meaning of the given words are

simmer : to cook gently in a liquid that is almost boiling.

seethe : to be very angry

smolder : to burn slowly without a flame

break : to separate or make something separate, into two or more pieces

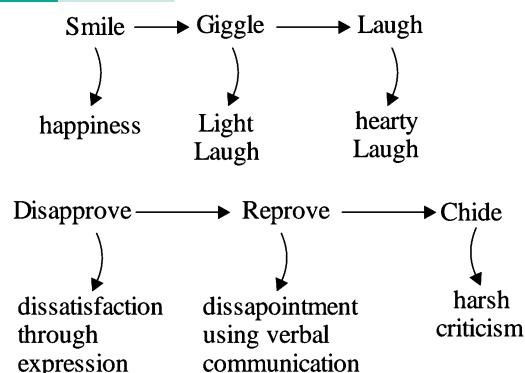
raze : to completely destroy a building, town, etc so that nothing is left.

From options :

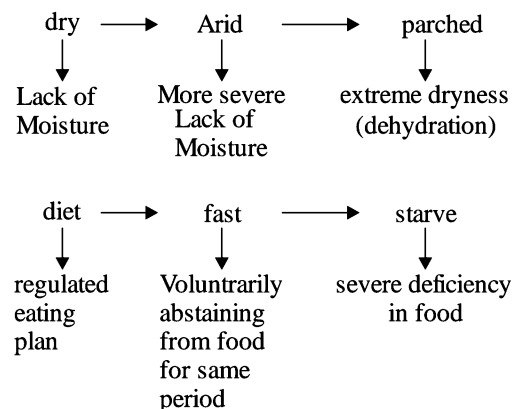
- (A) obfuscate : to make something unclear and more difficult to understand
- (B) obliterate : to remove all signs of something by destroying or covering it completely
- (C) fracture : a fracture is a partial or complete break in the bone
- (D) fissure : a narrow opening or and depth usually occurring from some breaking or parting

From the above options and there meaning we see options (A), (C) and (D) are not appropriate for gives analogy and option (B) is logical in the analogy.

Hence, the correct option is (B).

1.33 (A)

Hence, the correct option is (A).

1.34 (A)

Hence, the correct option is (A).

1.35 (C)

Given : [walk → jog → sprint]

‘→’ denote increasing order of intensity

[bothered → ____ → daunted]

Meaning of given words

walk → to move or go somewhere by putting one foot in front of the other on the ground, but without running

jog → to run slowly especially as a form of exercise

sprint → to run a short distances as fast as you can

bothered → worried about something

daunted → to frighten or to worry some body by being too big or difficult

From options

- (A) Phased → carried out in gradual stages, staggered
- (B) Phrased → to express something in a particular way.
- (C) Fazed → to make some body worried or nervous
- (D) Fused → joined or blended to form a single entity.

From the above options and there meaning use see that options (A), (B) and (D) are not appropriate for given analogy and option (C) is logical in the analogy

Hence, correct option is (C).

1.36 (B)

Myopic : Myopic means short sighted

We have to find the most appropriate word from option that can change the word “myopic” without changing the meaning of the sentence.

From options :

From option (A) :

Visionary : Having great plans for the future.

It does not fit the context of the sentence.

Hence, option (A) is not correct

From option (B) :

Shortsighted : Not considering what will happen in the future.

It fits the context of the sentences as it is synonym to “Myopic”.

From option (C) :

Progressive : using moderns methods or ideas.

It does not fit the context of the sentence.

Hence option (C) is not correct.

From option (D) :

Innovative : using new methods or ideas.

It does not fit the context of the sentence.

Thus, option (D) is not correct.

Hence, the correct option is (B).

1.37 (A)

The given analogy is Courage : Bravery :: Yearning : _____.

Understanding the Relationship :

"Courage" and "Bravery" are synonymous; bravery is an expression or characteristic of courage.

"Yearning" means a strong desire or deep longing for something.

From option (A) :

Longing : This is the correct answer because "longing" is synonymous with "yearning."

From option (B) :

Yelling : This is incorrect because yelling is related to shouting, not yearning.

From option (C) :

Yawning : This is incorrect because yawning is an involuntary action related to tiredness or boredom, not desire.

From option (D) :

Glaring : This is incorrect because glaring means staring intensely, often angrily, which is unrelated to yearning.

Hence the correct option is (A).

1.38 (B)

Given : The word "nocturnal" means active during the night.

We need its antonym, i.e., a word with the opposite meaning.

- (A) **Normal** : Not related to day/night
 (B) **Diurnal** : Active during the day
 (C) **Abnormal** : Opposite of normal
 (D) **Exceptional** : Unusual or outstanding

Therefore, the antonym of "nocturnal" is :

Hence, the correct option is (B).

1.39 (A)

Column I	Meaning
Lonely	Alone
Literal	exact words
Lousy	very bad
Lethal	deadly

Column II

- Verbatim (*p*) → exact words
- Solitary (*q*) → alone
- Deadly (*r*) → lethal
- Terrible (*s*) → very bad

Matching :

- (i) Lonely → Solitary (*q*)
 (ii) Literal → Verbatim (*p*)
 (iii) Lousy → Terrible (*s*)
 (iv) Lethal → Deadly (*r*)

Hence, the correct option is (A).



2

Analogies

2010 IIT Guwahati

- 2.1 The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair.

Erudition : Scholar [TF]

- (A) steadfast : mercurial
- (B) competence : strict
- (C) skill : craftsman
- (D) nurse : doctor

- 2.2 The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair.

Preamble : Constitution [MN]

- (A) amendment : law
- (B) prologue : play
- (C) episode : serial
- (D) plot : story

- 2.3 The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair.

[All branches]

Unemployed : Worker

- (A) Fallow : Land
- (B) Unaware : Sleeper
- (C) Wit : Jester
- (D) Renovated : House

2011 IIT Madras

- 2.4 The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair :

Gladiator : Arena

[AG, CY, EC, EE, IN, MA, MT, XE, XL]

- (A) Dancer : Stage
- (B) Commuter : Train
- (C) Teacher : Classroom
- (D) Lawyer : Courtroom

2013 IIT Bombay

- 2.5 Select the pair that best expresses a relationship similar to that expressed in the pair :

[AE, AG, BT, CH, CY, MN, XE, XL]

Water : pipe ::

- (A) cart : road
- (B) electricity : wire
- (C) sea : beach
- (D) music : instrument

- 2.6 Select the pair that best expresses a relationship similar to the expressed in the pair

[AR, CE, GG, MA, MT, PH, TF]

Medicine : Health

- (A) Science : Experiment
- (B) Wealth : Peace
- (C) Education : Knowledge
- (D) Money : Happiness

2015 IIT Kanpur

- 2.7** Which one of the following combinations is incorrect? [CS-1, EE-1]
 (A) Acquiescence - Submission
 (B) Wheedle - Roundabout
 (C) Flippancy - Lightness
 (D) Profligate - Extravagant
- 2.8** Select the pair that best expresses a relationship similar to that expressed in the pair : [CE-1, CS-3]
Children : Pediatrician
 (A) Adult: Orthopaedist
 (B) Females: Gynaecologist
 (C) Kidney: Nephrologist
 (D) Skin: Dermatologist

2016 IISc Bangalore

- 2.9** Find the odd one in the following group of words. [CS-2, EE-1]
 mock, deride, praise, jeer
 (A) mock (B) deride
 (C) praise (D) jeer

2019 IIT Madras

- 2.10** A court is to a judge as _____ is to a teacher. [CH, CS]
 (A) A student (B) A punishment
 (C) A syllabus (D) A school

2020 IIT Delhi

- 2.11** Select the word that fits the analogy : [EC]
 Explicit : Implicit :: Express : _____.
 (A) Repress (B) Suppress
 (C) Compress (D) Impress
- 2.12** Select the word that fits the analogy [EE]
 Do : Undo :: Trust : _____.
 (A) Intrust (B) Untrust
 (C) Entrust (D) Distrust

- 2.13** Select the word that fits the analogy [IN, ME-1, MT, PE, PH]
 Build : Building :: Grow : _____.
 (A) Growth (B) Grew
 (C) Grewed (D) Grown

- 2.14** Select the word that fits the analogy : [CY, ME-2, PI]
 White : Whitening :: Light : _____.
 (A) Enlightening (B) Lightning
 (C) Lightening (D) Lighting

- 2.15** Select the word that fits the analogy : [CE-1]
 Fuse : Fusion :: Use : _____.
 (A) Usage (B) User
 (C) Uses (D) Usion

- 2.16** Select the word that fits the analogy : [CE-2]
 Partial : Impartial :: Popular : _____.
 (A) Unpopular (B) Impopular
 (C) Dispopular (D) Mispopular

- 2.17** Select the word that fits the analogy: [CS]
 Cook : Cook :: Fly : _____.
 (A) Flyer (B) Flying
 (C) Flew (D) Flighter

- 2.18** Select the word that fits the analogy: [AR, BM, BT, CH, MA, MN, ST, XE, XL]
 Cover : Uncover :: Associate : _____.
 (A) Unassociate (B) Dissociate
 (C) Inassociate (D) Misassociate

2021 IIT Bombay

- 2.19** Nostalgia is to anticipation as _____ is to _____.
 Which one of the following options maintains a similar logical relation in the above sentence? [EC, ES, PE, PI, ST]
 (A) Future, Past
 (B) Future, Present

- (C) Past, Future
(D) Present, Past
- 2.20** Oasis is to sand as island is to _____.
Which one of the following options maintains a similar logical relation in the above sentence? [AG, EE, EY, GG]
(A) Mountain (B) Stone
(C) Land (D) Water
- 2.21** _____ is to surgery as writer is to _____.
Which one of the following options maintains a similar logical relation in the above sentence?
[BT, CH, CS-1, MA, TF]
(A) Doctor, book
(B) Hospital, library
(C) Medicine, grammar
(D) Plan, outline
- 2.22** Pen: Write :: Knife : _____.
Which one of the following options maintains a similar logical relation in the above? [CS-2, XE, XL]
(A) Sharp (B) Cut
(C) Blunt (D) Vegetables.

2023 IIT Kanpur

- 2.23** Kind : _____ :: Often : Frequently
(By word meaning) [CSE]
(A) Type (B) Cruel
(C) Mean (D) Kindly
- 2.24** Planting : Seed :: Raising : ? [ME]
(A) Child (B) Temperature
(C) Height (D) Lift
- 2.25** Permit: _____ :: Enforce : Relax. (By word meaning) [EE]
(A) Allow (B) Forbid
(C) License (D) Reinforce

- 2.26** Courts : _____ : : Parliament : Legislature [ECE]

(by word meaning)

- (A) Judiciary (B) Executive
(C) Governmental (D) Legal

- 2.27** Disagree : Protest :: Agree : _____. [IN, XE]

(By word meaning)

- (A) Refuse (B) Pretext
(C) Recommend (D) Refute

- 2.28** Eject : Insert :: Advance : _____. (By word meaning) [CE-1]

- (A) Advent (B) Progress
(C) Retreat (D) Loan

- 2.29** Kind: _____ : : Often : Seldom
(By word meaning) [CE-2]

- (A) Cruel (B) Variety
(C) Type (D) Kindred

- 2.30** References : _____ : : Guidelines : Implement
(By word meaning)

- (A) Sight (B) Site
(C) Cite (D) Plagiarise

2025 IIT Roorkee

- 2.31** Here are two analogous groups, **Group-I** and **Group-II**, that list words in their decreasing order of intensity. Identify the missing word in **Group-II**. [ECE]
Group-I : Abuse → Insult → Ridicule
Group-II : _____ → Praise → Appreciate
(A) Extol (B) Prize
(C) Appropriate (D) Espouse

- 2.32 Good : Evil :: Genuine : _____
Select the most appropriate option to complete the analogy. [EE]

(A) Counterfeit (B) Contraband
(C) Counterfoil (D) Counterpart

- 2.33 Bird : Nest :: Bee : _____.
Select the correct option to complete the analogy. [IN, CS-2]

(A) Kennel (B) Hammock
(C) Hive (D) Lair

- 2.34 Fish : Shoal :: Lion : _____.
[ME, PE]

(A) Pride (B) School
(C) Forest (D) Series

2026 IIT Guwahati

- 2.35 If [EC]

Ref Fig → 15 34
12 34 → 864 E18

Then

GATE-2026 → ?
Aptitude Test

- | | |
|------------------|------------------|
| P. 1234 56789 | Q. 98765 43210 |
| 01234 - 56789 | 98765 - 01234 |
| 98765 43210 | 1234 56789 |
| R. 01234 - 56789 | S. 56789 - 01234 |
| (A) P | (B) Q |
| (C) R | (D) S |

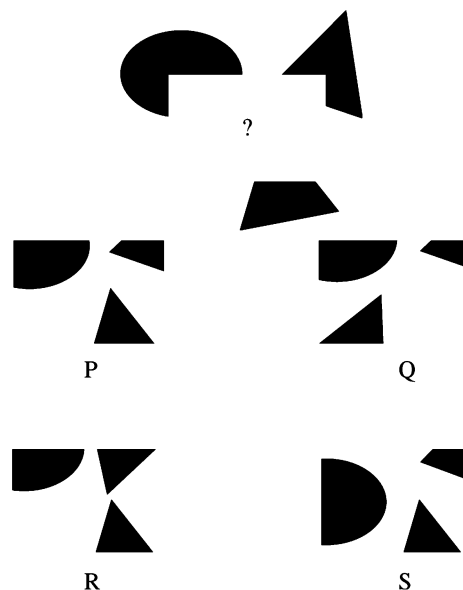
- 2.36 Exacerbate : Mitigate :: _____.
Choose the option with the correct pair of words to fill the blank. [IN, XE]

(A) Aggravate: Alleviate
(B) Alleviate: Precipitate
(C) Aggravate: Precipitate
(D) Emancipate: Exonerate

- 2.37 The figure below is supposed to show three non-overlapping shapes – one oval and two triangles. Which one of the following figures P, Q, R, or S fits the missing portion indicated by '?' and completes the oval and the two triangles? [EE, PI, CE-1]

and two triangles. Which one of the following figures P, Q, R, or S fits the missing portion indicated by '?' and completes the oval and the two triangles?

[EE, PI, CE-1]



- 2.38 Charity : P :: Retaliation : Q

Choose the appropriate pair of words P and Q that fit the analogy. [CH]

- (A) P = Parsimonious; Q = Vengeful
(B) P = Altruistic; Q = Amicable
(C) P = Resentful; Q = Spiteful
(D) P = Magnanimous; Q = Vindictive

- 2.39 Water : P :: Food : Q

Choose the P and Q combination from the options below to form a meaningful analogy. [CS-2]

- (A) P = Thirst; Q = Hunger
(B) P = Drink; Q = Hunger
(C) P = Thirst; Q = Satiated
(D) P = Wet; Q = Critic

Answers

Analogies

2.1	C	2.2	B	2.3	A	2.4	A	2.5	B
2.6	C	2.7	B	2.8	B	2.9	C	2.10	D
2.11	A	2.12	D	2.13	A	2.14	D	2.15	A
2.16	A	2.17	A	2.18	B	2.19	C	2.20	D
2.21	A	2.22	B	2.23	A	2.24	A	2.25	B
2.26	A	2.27	C	2.28	C	2.29	A	2.30	C
2.31	A	2.32	A	2.33	C	2.34	A	2.35	C
2.36	A	2.37	A	2.38	D	2.39	A		

Explanations

Analogies

2.1 (C)

As the relation between scholarship and scholar the same relation states option (C).

Skill : Craftsman

Hence, the correct option is (C).

2.2 (B)

As preamble is introductory to constitution in the same way prologue is introductory to play.

Hence, the correct option is (B).

2.3 (A)

Given :

Unemployed : Worker

A worker who does not have a job is called unemployed.

Fallow : Land

A land which is not used for farming for a season is called fallow.

Unaware : Sleeper

Someone who is sleeping and is unaware of things that are happening around.

Wit : Jester

Jester : A professional joker or clown.

Wit : Sharpness, cleverness, intelligence.

Renovated : House

Improving the condition of a house is called renovation.

Only option (A) best expresses the relation in the original pair.

Hence, the correct option is (A).

2.4 (A)

Gladiator performs his action in arena, similarly dancer's performance requires stage. A person, usually a professional combatant, a captive, or a slave, trained to entertain the public by engaging in mortal combat with another person or a wild animal in the ancient Roman arena is known as Gladiator.

Arena : An enclosed area for the presentation of sports events and spectacles.

Dancer : A performer who dances professionally.

Stage : A raised platform on which theatrical performances are presented.

Commuter : One that travels regularly from one place to another, as from suburb to city and back.

Train : A series of connected railroad cars pulled or pushed by one or more locomotives.

Teacher : One who teaches, especially one hired to teach.

Classroom : A room of place specially in a school in which classes are conducted.

Lawyer : One whose profession is to give legal advice and assistance to clients and represent them in court or in other legal matters.

Courtroom : A room in which the proceedings of a court are held.

As Gladiator performs and entertains people in arena, dancers perform and entertain people on stage.

Hence, the correct option is (A).

2.5 (B)

Water : pipe

Water flows through the pipe.

From all the options, option (B) is the most appropriate because electricity flows through the wire. This process is very similar to the given pair.

Hence, the correct option is (B).

2.6 (C)

The relation between medicine and health can be best expressed in a way as medicine improves quality of health.

Similarly, education helps to improve knowledge.

Hence, the correct option is (C).

2.7 (B)

Acquiescence : The reluctant acceptance of something without protest.

Submission : The action of accepting or yielding to a superior force.

Wheedle : Get to do something by gentle urging special attention or flattery.

Roundabout : Not straight forward or direct.

Flippancy : Lack of respect or seriousness.

Lightness : Lack of depth or seriousness.

Profligate : Recklessly extravagant or wasteful in the use of resources.

Extravagant : Lack of restraint or exceeding what is reasonable.

Only the combination in option (B) have different meanings.

Hence, the correct option is (B).

2.8 (B)

Children : Pediatrician

Pediatricians are the doctors who are specialist in treatment and care of children only.

Option (A) : Adult : Orthopedist

Orthopedists are the doctors who are specialist in treatment and care of bones.

[Includes men, women and kids]

Option (B) : Females : Gynecologist

Gynecologist are the doctor who are specialist in treatment of the female reproductive systems [Specific for women]

Option (C) : Kidney : Nephrologist

Nephrologists are the doctors who are specialist in treatment of kidney related problems. [Includes men, women and kids]

Option (D) : Skin : Dermatologist

Dermatologist are the doctors who are specialist in treatment of skin.

[Includes men, women and kids]

Only option (B) expresses relationship similar to the given pair.

Hence, the correct option is (B).

2.9 (C)

Mock, deride and jeer are synonyms which means mockery or making fun. Therefore, the odd one is '**praise**'. Praise means admiration, compliment, magnification.

Hence, the correct option is (C).

2.10 (D)

Court is a place where judge rules, so according to given options, a school is a place where teacher rules.

Hence, the correct option is (D).

2.11 (A)

Given words in the first relation are antonyms, the correct antonym of express is Repress.

Hence, the correct option is (A).

2.12 (D)

Given words in the first pair are antonyms, correct antonym for Trust is distrust.

Hence, the correct option is (D).

2.13 (A)

Since the pair build – building is verb noun. Similarly : **Grow : Growth**

Hence, the correct option is (A).

2.14 (D)

White : Whitening : : Light-lighting [Gerund form].

Hence, the correct option is (D).

2.15 (A)

“Fuse : Fusion” is a verbs and noun pair

Therefor, “Use : Usage” is correct pair.

2.16 (A)

“Partial - Impartial” are antonyms

Similarly, “Popular - Unpopular”

Hence, the correct option is (A).

2.17 (A)

From the given analogy, first pair “Cook - cook” is a verb - noun pair, thus “fly - flyer” is the correct pair.

Hence, the correct option is (A).

2.18 (B)

Uncover is the antonym of cover. So, antonym of associate is dissociate.

Hence, the correct option is (B).

2.19 (C)

Nostalgia : Recollection of a period in the past.

Anticipation : Expectation or prediction to future.

Hence, the correct option is (C).

2.20 (D)

Oasis is a fertile land surrounded by sand.

Island is a fertile land surrounded by water.

Hence, the correct option is (D).

2.21 (A)

As Doctor preforms surgery

Writer writes a Book.

Hence, the correct option is (A).

2.22 (B)

As pen is used for writing

Knife is used for cutting

Hence, the correct option is (B).

2.23 (A)

Given : Often is related with frequency. As often means, may times and frequently means continuously they both are related in same meaning with each other.

In the same way of relationship kind is related to type, as meaning of kind and type are same.

Option (B) cruel and option (C) mean cannot be related with kind according to the given relationship.

Option (D) kindly, cannot be related with kind as it does not satisfied the characteristics of given relationship.

Hence, the correct option is (A).

2.24 (A)

Given : Planting is related to seeding specific manner putting seeds into the soil and taking care of them so that they can grow. In the same way raising is related to child graving a child by taking care of him/her can be related as raising.

Hence, the correct option is (A).

2.25 (B)

Given : Enforce is related to relax in a special manner, enforce and relax are opposite in meaning. In the same way of relationship opposite meaning of permit will be forbid.

2.26 (A)

Given : Parliament is related to legislature in a special manner as parliament is legislative body. In the same way courts is related to judiciary as courts are judiciary body.

Hence, the correct option is (A).

2.27 (C)

Given : disagree is related with protest in a special manner, as disagree is feeling of our choice and protest is resultant action as when we disagree with something we protest against it. In the same relationship agree will be related to recommend.

Here, agree is our internal feeling and recommend is external resultant action as when we are agreed with something we do recommend.

Hence, the correct option is (C).

2.28 (C)

Given : Eject is related to insert in a special manner as they are opposite in meaning for each other. In the same way of relationship advance will be related to retreat, as advance means forward and retreat means backward.

Hence, the correct option is (C).

2.29 (A)

Given : Often is related to seldom in special manner as they are opposite to each other in meaning. In the same way of relationship kind will be related to cruel as they are opposite to each other in meaning.

Hence, the correct option is (A).

2.30 (C)

Given : Sight means, a thing that one sees or that can be seen

Site means, build (some thing) in a particular place.

Cite means, quote (a passage or book) as evidence for refer

Plagiarise means, the practice of taking some one else's work

As guidelines are related with word implement in the same way references is related with cite. Guidelines are implemented and references are cited.

Hence, the correct option is (C).

2.31 (A)

Given :

Group 1 : Abuse → Insult → Ridicule

Group 2 : _____ → Praise → Appreciate

The words are arranged in decreasing order of intensity.]

- **Abuse :** The strongest form of negative speech.
- **Insult :** Less severe than abuse but still offensive.
- **Ridicule :** Making fun of someone, which is the least intense.
- **Praise :** A strong positive expression.
- **Appreciate :** is a milder of positive recognition.

The missing word should stronger than praise in terms of positive intensity.

From option A :

Extol : Means to praise highly even more than just praise.

Hence, the correct option is (A).

2.32 (A)

Given : Good : Evil :: Genuine : _____

We need to find a word that has the same opposite relationship with “Genuine” as “Evil” has with “Good”

- (i) Good and Evil are antonyms
- (ii) Genuine means authentic, real or original.
- (iii) The opposite of Genuine would be fake, false, or counterfeit.

Counterfeit is the best choice because it means fake or not genuine, which directly contrasts with Genuine.

Hence, the correct option is (A).

2.33 (C)

Given : Bird : Nest :: Bee : _____

We need to find a word that has the same analogy with “Bee” as “Nest” has with “Bird”.

- (i) Bird lives in Nest.
- (ii) Bee lives in Hive.

“Hive” is the best choice because it is the home of “bee”.

Hence, the correct option is (C).

2.34 (A)

Given : Fish : Shoal :: Lion : ?

- Shoal is the collective noun for a group of fish.
- The correct collective noun for a group of lions is pride.

Hence the correct option is (A).

2.35 (C)**2.36 (A)**

Exacerbate : Mitigate

Exacerbate → make something worse

Mitigate → make something less severe

So the relation is the opposite meaning (antonyms).

Check options:

Aggravate → make worse

Alleviate → reduce severity

Thus the same relationship holds.

Aggravate : Alleviate

Hence, the correct option is (A).

2.37 (A)

The figure should form:

- (i) 1 oval
- (ii) 2 triangles
- (iii) Non-overlapping shapes

The missing piece must:

- (i) complete the oval
- (ii) also form two triangles with other pieces.

Checking options:

P → the curved part completes the oval and remaining parts combine to form two triangles.

Q, R, S → either break the oval shape or do not create two triangles.

Therefore the correct piece is P.

Hence the correct option is (A).

2.38 (D)

- **Magnanimous :** Generous or forgiving, especially toward a rival or someone less powerful. This perfectly describes the spirit of Charity.
 - **Vindictive :** Having or showing a strong or unreasoning desire for revenge. This perfectly describes the spirit of Retaliation.
- Hence, the correct option is (D).

2.39 (A)

- Water satisfies thirst.
- Food satisfies hunger.

Hence, the correct option is (A).



3

Sentence Completion

2010 IIT Guwahati

- 3.1 Choose the most appropriate word from the options given below to complete the following sentence :

If we manage to _____ our natural resources, we would leave a better planet for our children.

[All branches]

- (A) uphold (B) restrain
(C) cherish (D) conserve

- 3.2 Choose the most appropriate word from the options given below to complete the following sentence :

His rather casual remarks on politics _____ his lack of seriousness about the subject.

[All branches]

- (A) masked (B) belied
(C) betrayed (D) suppressed

- 3.3 Choose the most appropriate word from the options given below to complete the following sentence :

The two child norm with _____ for the violators will have significant implications for our demographic profile.

[TF]

- (A) Disincentives (B) Incitements
(C) Restrictions (D) Restraints

- 3.4 Choose the most appropriate word from the options given below to complete the following sentence :

There is no fixed relation between food and famine; famines can occur with or without a substantial _____ in food output.

[TF]

- (A) Aberration (B) Weakening
(C) Decline (D) Deterioration

- 3.5 Choose the most appropriate word from the options given below to complete the following sentence :

The committee wrote a _____ report, extolling only the strengths of the proposal.

[MN]

- (A) Reasonable (B) Supportive
(C) Biased (D) Fragmented

- 3.6 Choose the most appropriate word from the options given below to complete the following sentence :

If the country has to achieve real prosperity, it is _____ that the fruits of progress reach all, and in equal measure.

[MN]

- (A) Inevitable (B) Contingent
(C) Oblivious (D) Imperative

2011 IIT Madras

- 3.7 Choose the most appropriate word or phrase from the options given below to complete the following sentence.

The environmentalists hope _____
the lake to its pristine condition.

[GG, TF]

- (A) in restoring
- (B) in the restoration of
- (C) to restore
- (D) restoring

- 3.8 Choose the most appropriate word from the options given below to complete the following sentence. [GG, TF]

Despite the mixture's _____ nature, we found that by lowering its temperature in the laboratory we could dramatically reduce its tendency to vaporize.

- (A) Acerbic (B) Resilient
- (C) Volatile (D) Heterogeneous

- 3.9 Choose the most appropriate words from the options given below to complete the following sentence. [GG, TF]

Because she had a reputation for _____ we were surprised and pleased when she greeted us so _____.

- (A) insolence irately
- (B) insouciance curtly
- (C) graciousness amiably
- (D) querulousness affably

- 3.10 Choose the most appropriate word(s) from the options given below to complete the following sentence.

We lost confidence in him because he never _____ the grandiose promises he had made. [AE, MN]

- (A) Delivered (B) Delivered on
- (C) Forgot (D) Reneged on

- 3.11 Choose the word or phrase that best completes the sentence below.

_____ in the frozen wastes of Arctic takes special equipment.

[AE, MN]

- (A) To survive (B) Surviving
- (C) Survival (D) That survival

- 3.12 Choose the most appropriate word from the options given below to complete the following sentence.

The _____ of evidence was on the side of the plaintiff since all but one witness testified that his story was correct. [AE, MN]

- (A) paucity (B) propensity
- (C) preponderance (D) accuracy

- 3.13 Choose the most appropriate word from the options given below to complete the following sentence :

Under ethical guidelines recently adopted by the Indian Medical Association, human genes are to be manipulated only to correct diseases for which _____ treatments are unsatisfactory.

[AG, CY, EC, EE, IN, MA, MT, XE, XL]

- (A) similar (B) most
- (C) uncommon (D) available

- 3.14 Choose the most appropriate word from the options given below to complete the following sentence :

It was her view that the country's problems had been _____ by foreign technocrats, so that to invite them to come back would be counter-productive.

[AG, CY, EC, EE, IN, MA, MT, XE, XL]

- (A) identified (B) ascertained
- (C) exacerbated (D) analysed

- 3.15 Choose the most appropriate word from the options given below to complete the following sentence.

If you are trying to make a strong impression on your audience, you cannot do so by being understated, tentative or _____

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) Hyperbolic (B) Restrained
(C) Argumentative (D) Indifferent
- 3.16** Choose the most appropriate word (s) from the option given below to complete the following sentence.

I contemplated _____ Singapore for my vacation but decided against it.

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) To visit
(B) Having to visit
(C) Visiting
(D) For a last

2012 IIT Delhi

- 3.17** Choose the most appropriate word from the options given below to complete the following sentence :

Given the seriousness of the situation that he had to face, his _____ was impressive.

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) beggary (B) nomenclature
(C) jealousy (D) nonchalance

- 3.18** Choose the most appropriate alternative from the options given below to complete the following sentence :

Suresh's dog is the one _____ was hurt in the stampede.

[BT, CE, CH, CS, ME, PH, PI]

- (A) That (B) Which
(C) Who (D) Whom

- 3.19** Choose the most appropriate alternative from the options given below to complete the following sentence:

Despite several _____ the mission succeeded in its attempt to resolve the conflict.

[BT, CE, CH, CS, ME, PH, PI]

- (A) Attempts (B) Setbacks
(C) Meetings (D) Delegations

- 3.20** Choose the most appropriate pair of words from the options given below to complete the following sentence:

The high level of _____ of the questions in the test was _____ by an increase in the period of time allotted for answering them. [AR, GG, TF]

- (A) difficulty, compensated
(B) exactitude, magnified
(C) aptitude, decreased
(D) attitude, mitigated

- 3.21** Choose the most appropriate alternative from the options given below to complete the following sentence: [AE, AG, MN]

I _____ to have bought a diamond ring.

- (A) have a liking
(B) should have liked
(C) would like
(D) may like

- 3.22** Choose the most appropriate alternative from the options given below to complete the following sentence: [AE, AG, MN]

Food prices _____ again this month.

- (A) have raised
(B) have been raising
(C) have been rising
(D) have arose

- 3.23** Choose the most appropriate alternative from the options given below to complete the following sentence:

The administrators went on to implement yet another unreasonable measure, arguing that the measures were already _____ and one more would hardly make a difference.

[AE, AG, MN]

- (A) reflective (B) utopian
(C) luxuriant (D) unpopular

- 3.24 Choose the most appropriate alternative from the options given below to complete the following sentence: [AE, AG, MN]
To those of us who had always thought him timid, his ____ came as a surprise.
 (A) intrepidity (B) inevitability
 (C) inability (D) inertness

2013 IIT Bombay

- 3.25 Friendship, no matter how _____ it is, has its limitations.
 [AR, CE, GG, MA, MT, PH, TF]
 (A) cordial (B) intimate
 (C) secret (D) pleasant
- 3.26 Complete the sentence :
 Universalism is to particularism as diffuseness is to _____.
 [CS, ME, PI]
 (A) Specificity (B) Neutrality
 (C) Generality (D) Adaptation

2014 IIT Kharagpur

- 3.27 The value of one U.S. dollar is 65 Indian Rupees today, compared to 60 last year. The Indian Rupee has _____.
 [EC-3, ME-3]
 (A) Depressed (B) Depreciated
 (C) Appreciated (D) Stabilized
- 3.28 Choose the most appropriate word from the options given below to complete the following sentence.
Many ancient cultures attributed disease to supernatural causes. However, modern science has largely helped _____ such notions.
 [EC-1, ME-1]
 (A) impel (B) dispel
 (C) propel (D) repel
- 3.29 Choose the most appropriate pair of words from the options given below to complete the following sentence.

She could not _____ the thought of _____ the election to her bitter rival.

[EC-2, ME-2]

- (A) bear, loosing (B) bare, loosing
 (C) bear, losing (D) bare, losing

- 3.30 After the discussion, Tom said to me, "Please revert!". He expects me to _____.
 [EC-4, ME-4]

- (A) retract
 (B) get back to him
 (C) move in reverse (D) retreat

- 3.31 Choose the most appropriate word from the options given below to complete the following sentence.

He could not understand the judges awarding her the first prize, because he thought that her performance was quite _____.
 [CS-1, EE-1]

- (A) superb (B) medium
 (C) mediocre (D) exhilarating

- 3.32 Choose the most appropriate word from the options given below to complete the following sentence.

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

_____ is the key to their happiness; they are satisfied with what they have.

- (A) Contentment (B) Ambition
 (C) Perseverance (D) Hunger

- 3.33 Choose the most appropriate word from the options given below to complete the following sentence. One of his biggest _____ was his ability to forgive.

[AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

- (A) Vice (B) Virtues
 (C) Choices (D) Strength

2015 IIT Kanpur

- 3.34 Choose the most appropriate word from the options given below to complete the following sentence.

- The principal presented the chief guest with a ____, as token of appreciation. [AG, AR, BT, CH, CY, EC-1, EY, XE, XL]
 (A) momento (B) memento
 (C) momentum (D) moment
- 3.35 Didn't you buy ____ when you went shopping? [CS-1, EE-1]
 (A) any paper (B) much paper
 (C) no paper (D) a few paper
- 3.36 We ____ our friend's birthday and we ____ how to make it up to him. [CS-2, EE-2]
 (A) completely forgot---don't just know
 (B) forgot completely---don't just know
 (C) completely forgot---just don't know
 (D) forgot completely---just don't know
- 3.37 Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence :
 Apparent lifelessness ____ dormant life.
 [AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]
 (A) Harbours (B) Leads to
 (C) Supports (D) Affects
- 3.38 Extreme focus on syllabus and studying for tests has become such a dominant concern of Indian students that they close their minds to anything ____ to the requirements of the exam. [CE-1, CS-3]
 (A) related (B) extraneous
 (C) outside (D) useful
- 3.39 The Tamil version of ____ John Abraham-starrer *Madras Cafe* ____ cleared by the Censor Board with no cuts last week, but the film's distributors ____ no takers among the exhibitors for a release in Tamil Nadu ____ this Friday. [CE-1, CS-3]
 (A) Mr., was, found, on
 (B) a, was, found, at
 (C) the, was, found, on
 (D) a, being, find at
- 2016 IISc Bangalore**
- 3.40 Despite the new medicine's ____ in treating diabetes, it is not ____ widely. [EC-1, ME-1]
 (A) effectiveness — prescribed
 (B) availability — used
 (C) prescription — available
 (D) acceptance — prescribed
- 3.41 The students ____ the teacher on teachers' day for twenty years of dedicated teaching. [EC-2, ME-3]
 (A) facilitated (B) felicitated
 (C) fantasized (D) facillitated
- 3.42 The man who is now Municipal Commissioner worked as _____. [CS-2, EE-1]
 (A) the security guard at a university.
 (B) a security guard at the university.
 (C) a security guard at university.
 (D) the security guard at the university.
- 3.43 The chairman requested the aggrieved shareholders to ____ him. [AE, EE-2, TF, XE, XL]
 (A) bare with (B) bore with
 (C) bear with (D) bare
- 3.44 A rewording of something written or spoken is a _____. [CE-1, CS-1]
 (A) Paraphrase (B) Paradox
 (C) Paradigm (D) Paraffin
- 3.45 Archimedes said, "Give me a lever long enough and a fulcrum on which to place it and I will move the world. "The sentence above is an example of a - _____ statement. [CE-1, CS-1]

- (A) Figurative (B) Collateral
(C) Literal (D) Figurine
- 3.46** The unruly crowd demanded that the accused be _____ without trial.
[BT, CH, GG, ME-2, MN, PH]
- (A) Hanged (B) Hanging
(C) Hankering (D) Hung

2017 IIT Roorkee

- 3.47** The ninth and the tenth of this month are Monday and Tuesday _____.
[AE, EC-2, MA, MT, PE, PH]
- (A) figuratively
(B) retrospectively
(C) respectively
(D) rightfully
- 3.48** _____ with someone else's email account is now a very serious offence.
[CE-1, CH, MN]
- (A) Involving (B) Assisting
(C) Tampering (D) Incubating
- 3.49** As the two speakers became increasingly agitated, the debate became _____.
[AR, ME-1, TF]
- (A) lukewarm (B) poetic
(C) forgiving (D) heated
- 3.50** He was one of my best _____ and I felt his loss _____. [AR, ME-1, TF]
- (A) friend, keenly
(B) friends, keen
(C) friend, keener
(D) friends, keenly
- 3.51** If you choose plane *P*, you will have to _____ plane *Q* as these two are mutually _____. [AG, GG, ME-2]
- (A) forgo, exclusive
(B) forget, inclusive
(C) accept, exhaustive
(D) adopt, intrusive

2018 IIT Guwahati

- 3.52** "Even though there is a vast scope for its _____, tourism has remained a/an _____ area."
The words that best fill the blanks in the above sentence are [EC]
- (A) Improvement, neglected
(B) Rejection, approved
(C) Fame, glum
(D) Interest, disinterested
- 3.53** "By giving him the last _____ of the cake, you will ensure lasting _____ in our house today."
The word that best fill the blank in the above sentence are [EC]
- (A) peas, piece (B) piece, peace
(C) peace, piece (D) peace, peas
- 3.54** "Since you have gone off the _____ the _____ sand is likely to damage the car".
The words that best fill the blanks in the above sentence are [EE]
- (A) course, coarse (B) course, course
(C) coarse, course (D) coarse, coarse
- 3.55** "A common misconception among writers is that sentence structure mirrors thought, the more _____ the structure, the more complicated the ideas."
The words that best fill the blanks in the above sentence are [EE]
- (A) detailed (B) simple
(C) clear (D) convoluted
- 3.56** "In spite of being warned repeatedly, he failed to correct his _____ behavior."
The word that best fills the blank in the above sentence is [AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]
- (A) rational (B) reasonable
(C) errant (D) good

- 3.57** “When she fell down the _____, she received many _____ but little help.”
The words that best fill the blanks in the above sentence are

[AG, AR, BT, CH, CY, GG, IN, MT, PH, TF]

- (A) stairs, stares (B) stairs, stairs
(C) stares, stairs (D) stares, stares

- 3.58** The driver applied the _____ as soon as she approached the hotel where she wanted to take a _____? [CE-1]

- (A) Brake, Break (B) Break, Break
(C) Brake, Brake (D) Break, Brake

- 3.59** “It is no surprise that every society has had codes of behavior; however the nature of these codes is often _____.”

The word that best fills the blank in the above sentence is [CE-1]

- (A) Unpredictable (B) Simple
(C) Expected (D) Strict

- 3.60** “Although it does contain some pioneering ideas, one would hardly characterize the work as _____.”

The word that best fills the blank in the above sentence is [CE-2]

- (A) Innovative (B) Simple
(C) Dull (D) Boring

- 3.61** “His face _____ with joy when the solution of the puzzle was _____ to him.”

The words that best fill the blanks in the above sentence are [CE-2]

- (A) Shone, shown (B) Shone, shone
(C) Shown, shone (D) Shown, shown

- 3.62** Her _____ should not be confused with miserliness; she is ever willing to assist those in need.

[EY, ME-1, PE, XE, XL]

- (A) Cleanliness (B) Punctuality
(C) Frugality (D) Greatness

- 3.63** Going by the _____ that many hand make light work, the school _____ involved all the students in the task.

[EY, ME-1, PE, XE, XL]

- (A) Principle, Principal
(B) Principal, Principle
(C) Principle, Principle
(D) Principal, Principal

- 3.64** “The judge’s standing in the legal community, through shaken by false allegations of wrongdoing, remained _____.” The word that best fills the blank in the above sentence is

[AE, MA, ME-2, PI]

- (A) Undiminished (B) Damaged
(C) Illegal (D) Uncertain

- 3.65** “From where are they bringing their books? _____ bringing _____ books from _____.”

The words that best fill the blanks in the above sentence are [CS, MN]

- (A) Their, they’re, there
(B) They’re, their, there
(C) There, their, they’re
(D) They’re, there, there

- 3.66** “A _____ investigation can sometimes yield new facts, but typically organized ones are more successful.”

The word that best fills the blank in the above sentence is [CS, MN]

- (A) meandering (B) timely
(C) consistent (D) systematic

2019 IIT Madras

- 3.67** The lecture was attended by quite _____ students, so the hall was not very _____. [CE-1]

- (A) Few, quite (B) A few, quite
(C) Few, quiet (D) A few, quiet

3.68 Daytime temperatures in Delhi can _____ 40°C . [CE-2]

- (A) get (B) peak
(C) reach (D) stand

3.69 The growth rate of ABC Motors in 2017 was the same _____ XYZ motors in 2016. [CE-2]

- (A) as that off (B) as those of
(C) as off (D) as that of

3.70 The expenditure on the project _____ as follows: equipment Rs. 20 lakhs, salaries Rs. 12 lakhs, and contingency Rs. 3 lakhs. [CH, CS]

- (A) Break down (B) Break
(C) Breaks down (D) Breaks

3.71 The search engine's business model _____ around the fulcrum of trust.

[CH, CS]

- (A) Revolves (B) Plays
(C) Sinks (D) Bursts

3.72 The boat arrived _____ dawn. [EC]

- (A) in (B) under
(C) on (D) at

3.73 The passengers were angry _____ the airline staff about the delay. [EE]

- (A) about (B) towards
(C) with (D) on

3.74 I am not sure if the bus that has been booked will be able to _____ all the students. [EE]

- (A) accommodate (B) sit
(C) deteriorate (D) fill

3.75 Newspapers are a constant source of delight and recreation for me. The _____ trouble is that I read _____ many of them. [EE]

- (A) only, quite (B) even, too
(C) only, too (D) even, quite

3.76 The minister avoided any mention of the issue of women's reservation in private sector. He was accused of _____ the issue. [CY, ME-1, MN]

- (A) Skirting (B) Collaring
(C) Belting (D) Tying

3.77 John Thomas, an _____ writer, passed away in 2018 [CY, ME-1, MN]

- (A) Imminent (B) Prominent
(C) Eminent (D) Dominant

3.78 A final examination is the _____ of a series of evaluation that a student has to go through [ME-2, TF, XE, XL]

- (A) Consultation (B) Insinuation
(C) Culmination (D) Desperation

3.79 When he did not come home, she _____ him lying dead on the roadside somewhere. [EC]

- (A) notice (B) looked
(C) concluded (D) pictured

2020 IIT Delhi

3.80 The untimely loss of life is a cause of serious global concern as thousands of people get killed _____ accidents every year while many other die _____ diseases like cardio vascular diseases, cancer, etc.

[AE, AG, EC, GG]

- (A) in, of (B) during, from
(C) from, of (D) from, from

3.81 Stock markets _____ at the news of the coup. [EE, EY, TF]

- (A) plugged (B) plunged
(C) poised (D) probed

3.82 The recent measures to improve the output would _____ the level of production to our satisfaction

[CY, ME-2, PI]

- (A) equalise (B) speed
(C) increase (D) decrease

3.83 His hunger for reading is insatiable. He reads indiscriminately. He is most certainly a/an _____ reader. [CE-1]

- (A) voracious (B) precocious
(C) wise (D) all-round

3.84 His knowledge of the subject was excellent but his classroom performance was _____. [CS]

- (A) desirable
(B) extremely poor
(C) praiseworthy
(D) good

3.85 Despite a string of poor performances, the chances of K.L. Rahul's selection in the team are _____. [AR, BM, BT, CH, MA, MN, ST, XE, XL]

- (A) slim (B) bright
(C) uncertain (D) obvious

2021 IIT Bombay

3.86 The people _____ were at the demonstration were from all sections of society. [AG, EE, EY, GG]

- (A) whom (B) who
(C) which (D) whose

3.87 Getting to the top is _____ than staying in top. [CE-1, CY, IN]

- (A) easier (B) more easy
(C) much easy (D) easiest

3.88 Gauri said that she can play the keyboard _____ her sister. [CS-2, XE, XL]

- (A) as worse as (B) as nicest as
(C) as better as (D) as well as

2022 IIT Kharagpur

3.89 The _____ is too high for it to be considered _____. [CSE]

- (A) Fare/Fair (B) Fair/ Fare
(C) Faer/ Fair (D) Fare/fare

3.90 A palindrome is a word that reads the same forward and backward. In a game of words, a player has the following two plates painted with letters

A **D**

From the additional plates gives in the options, which one of the combinations of additional plates would allow the players to construct in five letter palindrome. The players should use all five plates exactly once. The plates can be rotated in their plane.

[CSE]

- (A) **R** **V** **Y**
(B) **Z** **E** **D**
(C) **I** **T** **Y**
(D) **D** **C** **T**

3.91 As you grow older, an injury to your _____ may take longer to _____. [EE]

- (A) heal/heal (B) heel/heel
(C) heel/heal (D) heal/heel

3.92 Healthy eating is a critical component of healthy aging. When should one start eating healthy? It turns out that it is never too early. For example babies who start eating healthy in the first year are more likely to have better overall health as they get older.

Which one of the following is correct logical inference based on the information in the above passage?

[CE-1]

- (A) Eating healthy and better overall health are more correlated at a young age, but not old age.

- (B) Eating healthy can be started at any age, earlier the better.
- (C) Healthy eating is more important for adult than kid.
- (D) Healthy eating is important for those with good health conditions but not for others.

2023 IIT Kanpur

- 3.93** We reached the station late, and _____ missed the train.

[CSE]

- (A) mostly (B) near
(C) utterly (D) nearly

- 3.94** Which one of the following sentence sequences creates a coherent narrative?

- (i) Once on the terrace, on her way to her small room in the corner, she notices the man right away.
- (ii) She begins to pant by the time she has climbed all the stairs.
- (iii) Mina has bought vegetables and rice at the market, so her bags are heavy.
- (iv) He was leaning against the parapet, watching the traffic below.

[CSE]

- (A) (iv), (ii), (i), (iii)
(B) (iii), (ii), (i), (iv)
(C) (ii), (iii), (i), (iv)
(D) (i), (ii), (iv), (iii)

- 3.95** The country of Zombieland is in distress since more than 75% of its working population is suffering from serious health issues. Studies conducted by competent health experts concluded that a complete lack of physical exercise among its working population was one of the leading causes of their health issues. As one of the measures to address the problem, the Government of Zombieland has decided to provide monetary

incentives to those who ride bicycles to work.

Based only on the information provided above, which one of the following statements can be logically inferred with certainty?

[CSE]

- (A) All the working population of Zombieland will henceforth ride bicycles to work.
- (B) Riding bicycles will ensure that all of the working population of Zombieland is free of health issues.
- (C) The health experts suggested to the Government of Zombieland to declare riding bicycles as mandatory.
- (D) The Government of Zombieland believes that riding bicycles is a form of physical exercise.

- 3.96** He did not manage to fix the car himself, so he _____ in the garage.

[ME]

- (A) got it fixed (B) getting it fixed
(C) gets fixed (D) got fixed

- 3.97** In a recently held parents-teacher meeting, the teachers had very few complaints about Ravi. After all, Ravi was a hardworking and kind student. Incidentally, almost all of Ravi's friends at school were hard working and kind too, but the teachers drew attention to Ravi's complete lack of interest in sports. The teachers believed that along with some of his friends who shows similar disinterest in sports, Ravi needed to engage in some sports for his overall development.

Based only on the information provided above, which one of the following statements can be logically inferred with certainty?

[ME]

- (A) All of Ravi's friends are hardworking and kind.
 (B) No one who is not a friend of Ravi is hardworking and kind.
 (C) None of Ravi's friends are interested in sports.
 (D) Some of Ravi's friends are hardworking and kind.

3.98 Which one of the sentence sequence in the given option creates a coherent narrative?

[CSE]

- (i) I could not bring myself to knock
 (ii) There was a number of unfamiliar voices coming from the big drawing room and the door was firmly shut.
 (iii) The passage was dark for a bit, but then it suddenly opened into a bright kitchen.
 (iv) I decided I would rather wander down the passage.
 (A) (iv), (i), (iii), (ii)
 (B) (iii), (i), (ii), (iv)
 (C) (ii), (i), (iv), (iii)
 (D) (i), (iii), (ii), (iv)

3.99 Rafi told Mary "I am thinking of watching a film this weekend". The following reports the above statement in indirect speech.

Rafi told Mary that he _____ of watching a film this weekend.

[EE]

- (A) thought (B) is thinking
 (C) am thinking (D) was thinking

3.100 Students of all the departments of a college who have successfully completed the registration process are eligible to vote in the upcoming college elections. However, by the time the due date of

registration was over, it was found that surprisingly none of the students from the Department of Human Sciences had completed the registration process.

Based only on the information provided above, which one of the following sets of statement(s) can be logically inferred with certainty?

[EE]

- (i) All those students who would not be eligible to vote in college elections would certainly belong to the Department of Human Sciences.
 (ii) None of the students from departments other than Human Sciences failed to complete the registration process within the due time.
 (iii) All the eligible voters would certainly be students who are not from the Department of Human Sciences.
 (A) (i) and (ii) (B) (i) and (iii)
 (C) only (i) (D) only (iii)

3.101 Which one of the options does NOT describe the passage below or follow from it?

We tend to think of cancer as a 'modern' illness because its metaphors are so modern. It is a disease of overproduction, of sudden growth, a growth that is unstoppable, tipped into the abyss of no control. Modern cell biology encourages us to imagine the cell as a molecular machine. Cancer is that machine unable to quench its initial command (to grow) and thus transform into an indestructible, self-propelled automaton.

[Adapted from *The Emperor of All Maladies* by Siddhartha Mukherjee]

[EE]

- (A) It is a reflection of why cancer seems so modern to most of us.
- (B) It tells us that modern cell biology uses and promotes metaphors of machinery.
- (C) Modern cell biology encourages metaphors of machinery, and cancer is often imagined as a machine.
- (D) Modern cell biology never uses figurative language, such as metaphors, to describe or explain anything

3.102 “I cannot support this proposal. My _____ will not permit it.”

[ECE]

- (A) conscious (B) consensus
- (C) conscience (D) consent

3.103 Which one of the following options can be inferred from the given passage alone?

When I was a kid, I was partial to stories about other worlds and interplanetary travel. I used to imagine that I could just gaze off into space and be whisked to another planet.

Which option can be inferred from the given passage above?

[Excerpt from *The Truth about Stories* by T. King]

[ECE]

- (A) It is a child’s description of what he or she likes.
- (B) It is an adult’s memory of what he or she liked as a child.
- (C) The child in the passage read stories about interplanetary travel only in parts.
- (D) It teaches us that stories are good for children.

3.104 Residency is a famous housing complex with many well-established individuals

among its residents. A recent survey conducted among the residents of the complex revealed that all of those residents who are well established in their respective fields happen to be academicians. The survey also revealed that most of these academicians are authors of some best-selling books.

Based only on the information provided above, which one of the following statements can be logically inferred with certainty?

- (A) Some residents of the complex who are well established in their fields are also authors of some best-selling books.
- (B) All academicians residing in the complex are well established in their fields
- (C) Some authors of best-selling books are residents of the complex who are well-established in their fields
- (D) Some academicians residing in the complex are well established in their fields.

3.105 The information contained in DNA is used to synthesize proteins that are necessary for the functioning of life. DNA is composed of four nucleotides: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G). The information contained in DNA can then be thought of as a sequence of these four nucleotides: A, T, C, and G. DNA has coding and non-coding regions. Coding regions where the sequence of these nucleotides are read in groups of three to produce individual amino acids—constitute only about 2% of human DNA. For example, the triplet of nucleotides CCG codes for

the amino acid glycine, while the triplet GGA codes for the amino acid proline. Multiple amino acids are then assembled to form a protein.

Based only on the information provided above, which of the following statements can be logically inferred with certainty?

[IN, XE]

- (i) The majority of human DNA has no role in the synthesis of proteins.
- (ii) The function of about 98% of human DNA is not understood.

- (A) only (i)
- (B) only (ii)
- (C) both (i) and (ii)
- (D) neither (i) nor (ii)

- 3.106** "I have not yet decided, what will I do this evening; I _____ visit a friend".

[CE-1]

- (A) Mite
- (B) Would
- (C) Might
- (D) Didn't

- 3.107** The James Webb telescope, recently launched in space, is giving humankind unprecedented access to the depths of time by imaging very old stars formed almost 13 billion years ago. Astrophysicists and cosmologists believe that this odyssey in space may even shed light on the existence of dark matter. Dark matter is supposed to interact only via the gravitational interaction and not through the electromagnetic-, the weak- or the strong-interaction. This may justify the epithet "dark" in dark matter. Based on the above paragraph, which one of the following statements is FALSE?

[CE-1]

- (A) No other telescope has captured images of stars older than those captured by the James Webb telescope.

(B) People other than astrophysicists and cosmologists may also believe in the existence of dark matter.

(C) The James Webb telescope could be of use in the research on dark matter.

(D) If dark matter was known to interact via the strong-interaction, then the epithet "dark" would be justified.

- 3.108** Elvesland is a country that has peculiar beliefs and practices. They express almost all their emotions by gifting flowers. For instance, if anyone gifts a white flower to someone, then it is always taken to be a declaration of one's love for that person. In a similar manner, the gifting of a yellow flower to someone often means that one is angry with that person.

Based only on the information provided above, which one of the following sets of statement(s) can be logically inferred with *certainty*?

- (i) In Elvesland, one always declares one's love by gifting a white flower.
- (ii) In Elvesland, all emotions are declared by gifting flowers.
- (iii) In Elvesland, sometimes one expresses one's anger by gifting a flower that is not yellow.
- (iv) In Elvesland, sometimes one expresses one's love by gifting a white flower.

[CE-2]

- (A) only (ii)
- (B) (i), (ii) and (iii)
- (C) (i), (iii) and (iv)
- (D) only (iv)

- 3.109** Based only on the following passage, which one of the options can be inferred with *certainty*?

When the congregation sang together, Apenyo would also join, though her little screams were not quite audible because of the group singing. But whenever there was a special number, trouble would begin; Apenyo would try singing along, much to the embarrassment of her mother. After two or three such mortifying Sunday evenings, the mother stopped going to church altogether until Apenyo became older and learnt to behave.

At home too, Apenyo never kept quiet; she hummed or made up silly songs to sing by herself, which annoyed her mother at times but most often made her become pensive. She was by now convinced that her daughter had inherited her love of singing from her father who had died unexpectedly away from home.

[Excerpt from *These Hills Called Home* by Temsula Ao]

[CE-2]

- (A) The mother was embarrassed about her daughter's singing at home.
- (B) The mother's feelings about her daughter's singing at home were only of annoyance.
- (C) The mother was not sure if Apenyo had inherited her love of singing from her father.
- (D) When Apenyo hummed at home, her mother tended to become thoughtful

3.110 "You are delaying the completion of the task. Send _____ contributions at the earliest."

[CH, PI]

- (A) you are (B) your
- (C) you're (D) yore

3.111 In 2022, June Huh was awarded the Fields medal, which is the highest prize in Mathematics.

When he was younger, he was also a poet. He did not win any medals in the International Mathematics Olympiads. He dropped out of college.

Based only on the above information, which one of the following statements can be logically inferred with certainty?

[CH, PI]

- (A) Every Fields medalist has won a medal in an International Mathematics Olympiad.
- (B) Everyone who has dropped out of college has won the Fields medal.
- (C) All Fields medalists are part-time poets.
- (D) Some Fields medalists have dropped out of college.

3.112 The World Bank has declared that it does not plan to offer new financing to Sri Lanka, which is battling its worst economic crisis in decades, until the country has an adequate macroeconomic policy framework in place. In a statement, the World Bank said Sri Lanka needed to adopt structural reforms that focus on economic stabilisation and tackle the root causes of its crisis. The latter has starved it of foreign exchange and led to shortages of food, fuel, and medicines. The bank is repurposing resources under existing loans to help alleviate shortages of essential items such as medicine, cooking gas, fertiliser, meals for children, and cash for vulnerable households.

Based only on the above passage, which one of the following statements can be inferred with certainty? [CH, PI]

- (A) According to the World Bank, the root cause of Sri Lanka's economic crisis is that it does not have enough foreign exchange.
- (B) The World Bank has stated that it will advise the Sri Lankan government about how to tackle the root causes of its economic crisis.
- (C) According to the World Bank, Sri Lanka does not yet have an adequate macroeconomic policy framework.
- (D) The World Bank has stated that it will provide Sri Lanka with additional funds for essentials such as food, fuel, and medicines.

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- 3.113** If ' $\rightarrow$ ' denotes increasing order of intensity, then the meaning of the words [talk $\rightarrow$ shout $\rightarrow$ scream] is analogous to [please $\rightarrow$ _____ $\rightarrow$ pander]. Which one of the given options is appropriate to fill the blank?

- (A) flatter (B) flutter
(C) fritter (D) frizzle

[EE]

- 3.114** In the given text, the blanks are numbered (i)-(iv). Select the best match for all the blanks.

From the ancient Athenian arena to the modern Olympic stadiums, athletics ___(i)___ the potential for a spectacle. The crowd ___(ii)___ with bated breath as the Olympian artist twists his body, stretching the javelin behind him. Twelve strides in, he begins to cross-step. Six cross-steps ___(iii)___ in an abrupt stop on his left foot. As his body ___(iv)___ like a door turning on a hinge, the javelin is launched skyward at a precise angle.

- (A) (i) hold (ii) waits (iii) culminates (iv) pivot
(B) (i) holds (ii) wait (iii) culminates (iv) pivot
(C) (i) hold (ii) wait (iii) culminate (iv) pivots
(D) (i) holds (ii) waits (iii) culminate (iv) pivots

[CE-1, CH]

- 3.115** If ' $\rightarrow$ ' denotes increasing order of intensity, then the meaning of the words [sick $\rightarrow$ infirm $\rightarrow$ moribund] is analogous to [silly $\rightarrow$ _____ $\rightarrow$ daft]. Which one of the given options is appropriate to fill the blank ?

- (A) frown (B) fawn
(C) vein (D) vain

[PI, DA]

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- 3.116** Had I learnt acting as a child, I _____ a famous film star.

Select the most appropriate option to complete the above sentence. [ECE]

- (A) will be
(B) can be
(C) am going to be
(D) could have been

- 3.117** Kavya _____ go to work yesterday as she _____ feeling well.

Select the most appropriate option to complete the above sentence. [EE]

- (A) didn't; isn't
(B) wouldn't; wasn't
(C) wasn't; wasn't
(D) couldn't; wasn't

- 3.118** Despite his initial hesitation, Rehman's _____ to contribute to the success of the project never wavered. Select the

most appropriate option to complete the above sentence. [IN, CS-2]

- (A) Ambivalence (B) Satisfaction
(C) Resolve (D) revolve

3.119 Is there any good show _____ television tonight?

Select the most appropriate option to complete the above sentence.

[CE-1,

CH]

- (A) in (B) at
(C) within (D) on

3.120 As the police officer was found guilty of embezzlement, he was _____ dismissed from the service in accordance with the Service Rules.

Select the most appropriate option to complete the above sentence.

[CE-1, CH]

- (A) sumptuously (B) brazenly
(C) unintentionally (D) summarily

3.121 **Column-I** has statements made by Shanthala; and **Column-II** has responses given by Kanishk.

Column – I		Column-II	
P.	This house is in a mess.	1.	Alright, I won't bring it up during our conversations.
Q.	I am not happy with the marks given to me.	2.	Well, you can easily look it up.
R.	Politics is a subject I avoid talking about.	3.	No problem, let me clear it up for you.
S.	I don't know what this word means.	4.	Don't worry, I will take it up with your teacher.

Identify the option that has the correct match between **Column-I** and **Column-II**. [PI, DA]

- (A) P-2; Q-3; R-1; S-4
(B) P-3; Q-4; R-1; S-2
(C) P-4; Q-1; R-2; S-3
(D) P-1; Q-2; R-4; S-3

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3.122 Each one of the following clues contains a keyword that is partially filled.

Clue 1 : Synonym of recognize (8 letters)
: _D_ NT_ FY

Clue 2 : A story long enough to fill a book (5 letters) : _ _ _EL

Clue 3 : Two of something (6 letters) : _ _ _PLE

Clue 4 : A fraction of something, split equally into two parts (4 letters) : _ _ _F
The first letter of each of the keywords can be rearranged to form a four-letter word.

Which one of the options below is a possible choice for the four-letter word?

[EC]

- (A) CHIN (B) COIN
(C) ITCH (D) NOSE

3.123 'The team _____ more than 300 runs in 20 overs _____ rains. However, some players needed to improve their batting skills.' Choose the option with the correct sequence of words to fill the blanks. [CE-2, ME]

- (A) score; despite
(B) scoring; instead of
(C) scored; despite
(D) scoring; in spite of

3.124 'People are crowding around ____ pit into which ____ elephant has fallen. I have never seen an elephant looking more

bewildered ____ miserable. Here it is in a most undignified position, thrust into a pit and made to look up ____ a vast, curiosity-stricken crowd.' [CE-2, ME]
Choose the option with the correct sequence of words to fill the blanks.

- (A) an; a; at; and (B) a; an; and; at
(C) and; a; an; at (D) at; a; an; and

3.125 The antonym of the word protagonist is _____. [CS-1]

- (A) Agnostic (B) Antagonist
(C) Arsonist (D) Anarchist

3.126 "He often _____ the numbers. False claims are not going to help. Honesty _____ trust", said the manager. Choose the option with the correct order of words to fill the blanks. [CH]

- (A) exaggerates; engenders
(B) excels; encourages
(C) aggravates; alleviates
(D) diminishes; eliminates

3.127 Verbosity : Brevity :: Insolence : _____. [DA]

Choose the word that best fills the blank.

- (A) Innocence (B) Respect
(C) Solace (D) Wealth

3.128 Expedite, Hasten, Hurry, _____. [CS-2]

Fill the blank by choosing a word with a meaning similar to that of the words given above.

- (A) Accelerate (B) Retard
(C) Provide (D) Disable

3.129 'My friend and I parted _____ the door _____ the cabin that I had rented _____ the night.' [DA]

Choose the option with the correct sequence of words to fill the blanks.

- (A) at; of; for (B) for; at; of
(C) of; for; in (D) in; of; for

Answers

Sentence Completion

3.1	D	3.2	C	3.3	A	3.4	C	3.5	C
3.6	D	3.7	C	3.8	C	3.9	D	3.10	B
3.11	C	3.12	C	3.13	D	3.14	C	3.15	B
3.16	C	3.17	D	3.18	A	3.19	B	3.20	A
3.21	C	3.22	C	3.23	D	3.24	A	3.25	B
3.26	A	3.27	B	3.28	B	3.29	C	3.30	B
3.31	C	3.32	A	3.33	B	3.34	B	3.35	A
3.36	C	3.37	A	3.38	B	3.39	C	3.40	A
3.41	B	3.42	B	3.43	C	3.44	A	3.45	A
3.46	A	3.47	C	3.48	C	3.49	D	3.50	D
3.51	A	3.52	A	3.53	B	3.54	A	3.55	D
3.56	C	3.57	A	3.58	A	3.59	A	3.60	A
3.61	A	3.62	C	3.63	A	3.64	A	3.65	B
3.66	A	3.67	D	3.68	C	3.69	D	3.70	C
3.71	A	3.72	D	3.73	C	3.74	A	3.75	C
3.76	A	3.77	C	3.78	C	3.79	D	3.80	A
3.81	B	3.82	C	3.83	A	3.84	B	3.85	B
3.86	B	3.87	A	3.88	D	3.89	A	3.90	A
3.91	C	3.92	B	3.93	D	3.94	B	3.95	D
3.96	A	3.97	D	3.98	C	3.99	D	3.100	D
3.101	D	3.102	C	3.103	B	3.104	D	3.105	C
3.106	C	3.107	D	3.108	D	3.109	D	3.110	B
3.111	D	3.112	C	3.113	A	3.114	D	3.115	D
3.116	D	3.117	D	3.118	C	3.119	D	3.120	D
3.121	B	3.122	A	3.123	C	3.124	B	3.125	B
3.126	A	3.127	B	3.128	A	3.129	A		

Explanations

Sentence Completion

3.1 (D)

Uphold : Cause to remain (not appropriate).**Restrain** : Keep under control (not appropriate).**Cherish** : Be fond of (not related).**Conserve** : Keep in safety and protect from harm, decay, loss or destruction (most appropriate).

Hence, the correct option is (D).

3.2 (C)

Masked : Hide under a false appearance (opposite).**Belied** : Be in contradiction with (not appropriate).**Betrayed** : Reveal unintentionally (most appropriate).**Suppressed** : To put down by force or authority (irrelevant).

Hence, the correct option is (C).

3.3 (A)

Disincentives : Fine or punishment

Incitements : The action of provoking unlawful behavior or urging someone to behave unlawfully.

Restrictions : Something that limits the number, amount, size, freedom etc.

Restraints : A limit or control on something
Basically, disincentives means some sort of fine or punishment for the people who will not follow the 2-child norm.

Hence, the correct option is (A).

3.4 (C)

Aberration : Sharp change.

Weakening : To become less strong; to make somebody/something less strong.

Decline : To become weaker, smaller or less good.

Deterioration : The action or process of becoming impaired or inferior in quality, functioning or condition.

“Weakening” and “deterioration” must be followed by “of” than “in”.

“Decline” perfectly fits here.

Hence, the correct option is (C).

3.5 (C)

Extol : To praise highly.

Reasonable : Fair, practical.

Supportive : To give help or assistance.

Biased : To favor one side or issue over another.

Fragmented : To break into small pieces.

From the sentence it is clear that the report is not reasonable but biased.

Here we see, a committee wrote a report which favors one side issue.

Hence, the correct option is (C).

3.6 (D)

Inevitable : That cannot be avoided or prevented from happening.

Contingent : A group of people from the same country, or a part of a military force.

Oblivious : Not conscious of something especially what is happening around you.

Imperative : The adjective imperative means that something is of the utmost importance or necessity.

From the sentence, it is clear that it is imperative that the fruits of progress reach all, and in equal measure.

Hence, the correct option is (D).

3.7 (C)

The environmentalists hope **to restore** the lake to its pristine condition.

The verb “HOPE” is always followed by (verb +infinitive (to) not verb+ing)

E.g. She hopes to go to abroad next year.

Hence, the correct option is (C).

3.8 (C)

Acerbic : means acidic tasting sour or bitter; does not mean it evaporates easily.

Resilient : means can be stretch easily, again does not say anything about evaporation.

Volatile : That can easily change into a gas, (most appropriate).

Heterogeneous : Means composed of different components; again not telling anything about evaporation.

Hence, the correct option is (C).

3.9 (D)

Part 1 of option (A) and option (B) is negative and part 2 of option (A) and option (B) is also negative part 1 and part 2 of option (C) both are positive but part 1 of option (D) is negative and

part 2 of option (D) is positive which leads them surprised and amazed.

Irate means angry and **curtly** means abrupt **amiably** and **affably** are synonyms to each other
Querulous : Impatient, moody, tempered, ill-natured etc.

Hence, the correct option is (D).

3.10 (B)

Delivered : This is not correct because it means promise was not made which contradicts the later part of sentence.

Delivered on : This is most appropriate, it means to do something one has promised or is expected to do.

For e.g. the contractor delivered on his promises to get the work done by Friday.

Forgot : Does not fit properly.

Reneged on : To not do what you previously agreed to do.

E.g. He reneged on his offer.

Hence, the correct option is (B).

3.11 (C)

“Surviving” is not correct because we are not having a noun here.

“That survival” is not appropriate

It is “survival” (noun form)

Hence, the correct option is (C).

3.12 (C)

Paucity : smallness of number and quantity or scarcity.

Propensity : Tendency.

Preponderance : The superiority or excess in number or quantity.

Accuracy : Freedom from mistake or error.

Plaintiff : A person who starts a legal action against somebody in a court of law.

So, here it means that the “plaintiff” brought a case to the court and all but one witness.

Hence, the correct option is (C).

3.13 (D)

Similar : Showing resemblance in qualities, characteristics, or appearance; alike but not identical.

Most : Superlative of many, much.

- (i) Greatest in number.
- (ii) Greatest in amount, extent, or degree.

Uncommon :

- (i) Not common; rare.
- (ii) Wonderful; remarkable

Available : Present and ready for use; at hand; accessible. (most appropriate)

Hence, the correct option is (D).

3.14 (C)

Identified :

- (i) To establish the identity of.
- (ii) To ascertain the origin, nature or definitive characteristics of.

Ascertained : To discover with certainty, as through examination or experimentation.

Exacerbated : To increase the severity, violence, or bitterness of ; aggravate.

Analyzed : To examine in detail in order to discover meaning, essential features, etc.

Hence, the correct option is (C).

3.15 (B)

The appropriate word to be filled in the blank should be closest in meaning to understated and tentative because the given sentence states that to leave a strong impression on audience, you can not have qualities such as understating or tentative.

Understated and tentative means not being clear or obvious.

Hyperbolic : Over explaining, exaggerating.

Restrained : Doing something in moderation or in limit. [closest in meaning]

Argumentative : Tending to argue or tendency to disagree.

Indifferent : Having no interest or care.

Hence, the correct option is (B).

3.16 (C)

Contemplate is a transitive verb and hence it is followed by **gerund**.

Gerund : A verb form which functions as a noun ending in “ing”.

Hence, the correct option is (C).

3.17 (D)

Considering the first half of the statement we can depict that “the situation was serious / intense” but the second half suggests that “his efforts / reactions were commendable”, thus it will be a “positive or a neutral word” but definitely not a “negative word.”

Beggary :

- (i) Extreme poverty, penury.
- (ii) The state or condition of being a beggar.

Nomenclature : The terminology used in particular science, art, activity, etc.

Jealousy : The state or quality of being jealous.

Nonchalance : The trait of remaining calm and seeming not to care, a causal lack of concern.

Hence, the correct option is (D).

3.18 (A)

‘Who’ and sometimes ‘that’ refer to people. ‘That’ and ‘which’ refer to groups or things.

‘That’ introduces essential clause to the sentence. Essential clause is the one that adds vital point to the sentence.

‘Which’ introduces a non-essential clause. Non-essential clause is the one which adds supplementary information.

Essential clauses do not have commas introducing or surrounding them, whereas non-essential clauses are introduced or surrounded by commas.

In the given sentence the essential clause is ‘_____ was hurt in the stampede’ because this part plays an important role in making sense of the given sentence. Therefore, for essential clause ‘that’ will be used.

Hence, the correct option is (A).

3.19 (B)

Delegations : A group of people who are chosen to vote or act for someone else.

The word ‘Despite’ indicates that there has to be a contrast in the sentence. The sentence states that mission succeeded in resolving the conflict. Therefore, the appropriate word should contradict the previous statement. Setback means delay in a process that is needed to be done. So, despite many problems or setbacks, the conflicts were resolved.

Hence, the correct option is (B).

3.20 (A)

Difficulty of the questions was **compensated** by an increase in time

This makes sense as with time one can expect to solve more difficult questions.

Exactitude means high level of correction and it won’t be magnified by an increase in time

Aptitude of the questions also does not decrease with an increase in time.

Attitude of the question does not make sense.

Hence, the correct option is (A).

3.21 (C)

I **would like** to have bought a diamond ring.

We use would like to have +v3 form when talking about things in the past we have missed.

Hence, the correct option is (C).

3.22 (C)

Rise is intransitive (prices rise) and

Raise is transitive (we raise prices)

Here, we need a present perfect form of 'Rise'.

Food prices **have been rising** again this month.

Hence, the correct option is (C).

3.23 (D)

"yet another unreasonable measure" and "measures were already" means that the new measure is surely unreasonable. "**unpopular**" is the most suitable word here.

"reflective" and "luxuriant" are not negative words and hence cannot fit here. "utopian" is far more negative than "unreasonable" and hence unsuitable.

Hence, the correct option is (D).

3.24 (A)

Explanation : **Timid** means fearful and **intrepid** means fearless which is the most suitable contrast.

Hence, the correct option is (A).

3.25 (B)

Cordial : Warm and friendly

Use of 'no matter how' in the sentence indicates that even if the friendship has a very close bond or intimate bond, it still has its limitations. Therefore, intimate is the appropriate word to complete the sentence.

Hence, the correct option is (B).

3.26 (A)

Universalism : Complete devotion in the interest of one and all.

Particularism : Special devotion in a particular interest.

Universalism and Particularism are opposite words. Similarly, we require a word which is opposite to diffuseness.

Specificity : Means the quality of being particular or specific.

Neutrality : Means not taking any side in a conflict.

Generality : Covering range of things rather than being specific. Similar to diffuseness.

Adaptation : Act of changing something or yourself to make it suitable for a situation.

Diffuseness refers to spreading or causing to spread in all directions. Specificity is an appropriate opposite.

Hence, the correct option is (A).

3.27 (B)

The value of rupees gets depreciated.

Depressed : sad.

Depreciated : lose value.

Appreciated : praised.

Stabilized : to make stable.

Last year 1\$ = Rs.60 $\Rightarrow$ 1 Rupee = $\frac{1}{60}$ \$

This year 1\$ = Rs.65 $\Rightarrow$ 1 Rupee = $\frac{1}{65}$ \$

$$\frac{1}{60} > \frac{1}{65}$$

So, it can be said that there is depreciation in rupee.

Hence, the correct option is (B).

3.28 (B)

Impel : To force somebody.

Dispel : To disappear something, especially an idea or notion.

Propel : To push.

Repel : To force back.

According to the sentence, ancient cultures pointed out that disease is caused due to supernatural causes. But modern science has helped to disappear such notions.

Hence, the correct option is (B).

3.29 (C)

Bear : To carry something.

Bare : Without anything.

Loosing : To loosen something.

Losing : Getting defeated in a battle.

Hence, the correct option is (C).

3.30 (B)

'Revert' means return to former state or reply; respond.

Retract : Taking back a given statement.

Get back to him : Reply or respond.

Retreat : Moving away or withdrawing from enemy forces.

Hence, the correct option is (B).

3.31 (C)

There is a contrast in the sentence, 'he could not understand why the judges were awarding her the first prize because he thought that her performance was' not up to the mark OR not very good.

Superb : Excellent.

Medium : A way of doing something.

Mediocre : Not very good.

Exhilarating : Feeling happy or thrilling.

As her performance was not so good, the word 'Mediocre' suffices the requirement.

Hence, the correct option is (C).

3.32 (A)

Contentment : State of complete satisfaction.

Ambition : Desire to achieve something.

Perseverance : Firmness, tenacity or the persistence.

Hunger : Having a strong desire to eat.

Given statement is made of two sentences. The blank space will be filled with the word which explains the reason of happiness in the first sentence. The second sentence actually helps in

figuring out the missing word. Since, they are satisfied with what they have which means they feel content with whatever they have and therefore, they are happy.

Hence, the correct option is (A).

3.33 (B)

Vice : Immoral, wicked or bad behaviour

Virtues : Moral behaviour or showing good behaviour.

One of his biggest virtues was his ability to forgive.

Hence, the correct option is (B).

3.34 (B)

Memento : A souvenir or gift.

Momento : An alternate spelling of memento.

Moment : A very short period of time.

Momentum : The force that keeps an object moving.

Hence, the correct option is (B).

3.35 (A)

'Much' is used for uncountable quantities, therefore it is inappropriate.

'No paper' is also inappropriate.

'A few' refers to a count of not more than 'two or three'. Therefore, a few **paper** is also inappropriate.

So, for the given sentence, "**any paper**" is the best and only suitable option.

Hence, the correct option is (A).

3.36 (C)

'**Completely**' is an adverb which should be used before the verb '**forgot**'. And '**just**' should be used before "**don't know**".

The words in option (C) are arranged in right sequence.

Hence, the correct option is (C).

3.37 (A)**Harbours/Harbor :** Giving home or shelter.**Dormant :** Temporarily inactive.**Affects :** Having an effect on.

According to all the options, option (A) is the most appropriate choice.

Hence, the correct option is (A).

3.38 (B)

The given sentence states that due to extreme focus on syllabus and tests, students have closed their minds.

Now, option (A) is incorrect because students are focused on studies so they can't close their minds to anything related to the requirements of the exam.

Extraneous means irrelevant or unrelated to the subject being dealt with. It is perfectly suitable and correct because students have closed their minds to anything that is unrelated to the requirements of the exam.

Hence, the correct option is (B).

3.39 (C)

The Tamil version of the John Abraham starrer Madras cafe was cleared by the Censor board with no cuts last week, but the film's distributors found no takers among the exhibitors for a release in Tamil Nadu on this Friday.

Hence, the correct option is (C).

3.40 (A)

'effectiveness' is noun and 'prescribed' is verb. These words are apt and befitting with the word 'medicine.'

Hence, the correct option is (A).

3.41 (B)

Felicitated : To compliment upon a happy event; congratulate or Honour.

Facilitated : No such word exists.

Facilitated : Make easy or easier.

Fantasized : Imagine something desirable.

Therefore, the most appropriate word is felicitated.

Hence, the correct option is (B).

3.42 (B)

Options (A) and (D) are incorrect because the post of security guard is a general post. So 'the security' is not correct. The word 'university' is always prefixed with 'the' being important. So, option (C) is also incorrect.

Hence, the correct option is (B).

3.43 (C)

Bare with : invitation to undress.

Bore with : past tense of bear with.

Bear with : tolerance or patience

Bare : it is an adjective and it means lacking the appropriate covering.

Hence, the correct option is (C).

3.44 (A)

Paraphrase : A restatement of a text, passage or a rewording of something written or spoken.

Paradox : A self-contradictory statement.

Paradigm : Pattern or mode.

Paraffin : Soft solid derived from petroleum.

Hence, the correct option is (A).

3.45 (A)

Figurative : Representing by a figure or resemblance or expressing one thing in terms, normally denoting another with which it may be regarded as analogous.

Collateral : It is an asset which is offered to secure a loan.

Literal : Taking words in their basic or usual meaning.

Figurine : A small model of human.

Hence, the correct option is (A).

3.46 (A)

Hankering : Having a strong desire towards something.

“hanged” means death by hanging, ‘hung’ is used only with things not living.

Hence, the correct option is (A).

3.47 (C)

Figuratively : It is an adjective, means “of the nature of or involving a figure of speech”.

Retrospectively : With contemplation of past situations, events.

Respectively : In precisely the order given.

Rightfully : Having a valid or just claim as to some property or position.

Hence, the correct option is (C).

3.48 (C)

Tampering : Modification in something which would be harmful for a person.

Incubating : Sitting on the eggs to hatch by keeping them warm.

Assisting : To help.

Involving : Causing someone to take part in something.

Tampering is the most suitable option.

Tampering with someone else’s email account is now a very serious offence.

Hence, the correct option is (C).

3.49 (D)

Lukewarm : Only slightly warm.

Poetic : Something like a poem.

Heated : Marked by excitement or angry feeling.

Agitated : Troubled or distributed or angry.

Since, the two speakers were getting angry the debate became heated.

Hence, the correct option is (D).

3.50 (D)

Keenly : Intensely, deeply.

The sentence states ‘one of my best’ meaning out of many best friends.

So, the sentence should be ‘He was one of my best friends and I felt his loss keenly.’

Hence, the correct option is (D).

3.51 (A)

Forgo : Leave, let go.

Exclusive : Not including both.

Inclusive : Including both.

Intrusive : Causing disruption.

The most suitable words are forgo and exclusive.

‘If you choose plan *P*, you will have to forgo plan *Q*, as these two are mutually exclusive.’

Hence, the correct option is (A).

3.52 (A)

(A) **Improvement** : Thing that represents an advancement.

Neglected : Not pay proper attention

(B) **Rejection** : The act of refusing to accept
Approved : To confirm or sanction formally.

(C) **Fame** : The state of being known or recognized by many people because of achievements, skills, etc.

Glum : Sad

Glum is a word for being depressed, bummed out or down in the dumps.

(D) **Interested** : Wanting to give your attention to something and discover more about it.

Disinterested : Having no personal involvement and therefore free to act fairly.

From the above options we see that options (B), (C) and (D) are not appropriate to the sentence, only option (A) is logical to the question.

Hence, the correct option is (A).

3.53 (B)

Peas : A spherical green seed which is eaten as a vegetable $\Rightarrow$ not appropriate

Piece : A limited portion or quantity of something $\Rightarrow$ most appropriate

Peace : Freedom from disturbance $\Rightarrow$ most suitable

Hence, the correct option is (B).

3.54 (A)

course : The route or direction followed by a ship, air craft or road.

coarse : Rough or harsh in texture.

Hence, the correct option is (A).

3.55 (D)

The misconception is that ideas or thoughts mirror the sentence structure i.e. thoughts and sentence structure are similar. If one of them is complicated then the other will be as well.

Convolutd : Extremely complex and difficult to follow.

From all the options, convoluted is the best suitable answer.

Hence, the correct option is (D).

3.56 (C)

Rational : Logical, With reason.

Errant : Deviant, Misbehaving, Offending.

In the given sentence, the person is warned again and again for his behavior. As it is clear that there is no need for a warning for good behavior which means the person is being warned for a bad or unexpected behavior.

Hence, the correct option is (C).

3.57 (A)

Stares : The act of looking directly at someone or something for a long time.

Stairs : A series of steps that go from one level or floor to another.

In the given sentence, the girl fell down the stairs and that is why a lot of people started looking at her or staring at her.

Hence, the correct option is (A).

3.58 (A)

Brake : Device for slowing or stopping a moving vehicle.

Break : Taking time off in between.

So, the correct flow of sentence is, 'The driver applied the brake as soon as she approached the hotel where she wanted to take a break.'

Hence, the correct option is (A).

3.59 (A)

The most suitable word here is unpredictable.

'It is no surprise that every society has had codes of behavior; however the nature of these codes is often unpredictable'.

Hence, the correct option is (A).

3.60 (A)

Word '**Although**' means in spite of the fact or even though.

The word '**innovative**' is most suitable because pioneering ideas means exploring something for the first time, similar to innovation but not exactly the same.

The given sentence states that the work contains some pioneering ideas but it can hardly be characterized as innovative.

Hence, the correct option is (A).

3.61 (A)

Shone : Shone is the second form of verb 'shine'. It means to glow, spark, or glitter.

Shown : Shown is the second and third form of verb 'show'. It means to display, exhibit or unveil.

Therefore, the correct flow of sentence will be,

“His face **shone** with joy when the solution of the puzzle was **shown** to him.”

Hence, the correct option is (A).

3.62 (C)

Miserliness : Excessive desire to save money, miser.

Frugality : Being economical with money or food.

In the given sentence, it is implied that one of her qualities is sometimes taken as miserliness but it should not be done. So, that quality is similar to miserliness.

Therefore, frugality is the most appropriate word.

Hence, the correct option is (C).

3.63 (A)

Principal : Someone of importance or of high rank.

Principle : Rule of action or conduct.

Going by the principle that many hand make light work, the school principal involved all the students in the task.

Hence, the correct option is (A).

3.64 (A)

Given sentence states that the judge was falsely accused of wrongdoing. The use of word ‘remained’ indicates that even after the false allegations, his standing in the legal community did not change or remained undiminished. Undiminished means not becoming any less or not tarnishing.

Hence, the correct option is (A).

3.65 (B)

They’re used for pointing group of people

Their is used for ownership or belongs to someone.

Their is used to introduce the subject of sentence. Also their is used to denote place or location.

Hence, the correct option is (B).

3.66 (A)

Meandering means wandering aimlessly or indirect.

Hence, the correct option is (A).

3.67 (D)

Quite : To a certain extent or to a significant amount.

Quiet : Silence, hushed.

Quite a few : A large number.

“The hall was not very **quite**”, does not make any sense. Here, the correct flow will be, “The hall was not very **quiet**”.

If Hall was not quiet, it means lecture was attended by enough students to make noise which indicates the use of ‘quite a few’.

Hence, the correct option is (D).

3.68 (C)

Daytime temperatures in Delhi can **reach** 40°C

Hence, the correct option is (C).

3.69 (D)

In the given sentence, growth rate of ABC motors and XYZ motors is said to be the same. The use of ‘off’ is incorrect therefore option (A) and (C) are wrong. Since, growth rate is singular noun, ‘those’ cannot be used. Therefore, the correct flow of the sentence will be,

“The growth rate of ABC motors in 2017 was the same **as that of** XYZ motors in 2016”.

Hence, the correct option is (D).

3.70 (C)

‘Break down’ means separating something into smaller parts. In the given sentence the expenditure is divided into different parts and the sentence is in present simple tense. Therefore, the correct usage will be “breaks down”.

Hence, the correct option is (C).

3.71 (A)

Fulcrum : Something that plays a central or essential role.

Here the correct word in the sentence will be 'revolves' because the given sentence emphasizes on the fact that search engine's model is based on trust.

Hence, the correct option is (A).

3.72 (D)

As the sentence is intended to specify particular time instant of the arrival of boat, hence 'at' is the most appropriate option. Also, we use 'at' before words like dawn.

Hence, the correct option is (D).

3.73 (C)

While expressing certain feelings towards someone, we use the word 'with' or 'of'. For example :

- (i) I am disappointed with you.
- (ii) I like being with you.
- (iii) I am so proud of you.

Therefore, the correct flow of the sentence will be,

"The passengers were angry **with** the airline staff about the delay."

Hence, the correct option is (C).

3.74 (A)

Accommodate : Fit in according to requirement or providing sufficient space. In the given options, only accommodate is the appropriate word.

Hence, the correct option is (A).

3.75 (C)

In the given statement, use of 'even' is inappropriate because it makes the sentence meaningless. Therefore, option (B) and (D) are incorrect. 'Quite' cannot be used before many (grammatically incorrect).

Hence, the correct option is (C).

3.76 (A)

Skirting : Avoid or try to avoid fulfilling, answering, or performing.

Collaring : Seize by the size or collar.

Belting : Strike someone by belt.

Tying : The act of tying or binding things together.

Hence, the correct option is (A).

3.77 (C)

Prominent : Having a quality that thrusts itself into attention.

Eminent : Standing above others in quality or position that is well qualified, renowned, notable, prestigious.

Imminent : About to occur.

Dominant : Most frequent or common.

Eminent is the suitable word because it defines the qualities that writer should have.

Hence, the correct option is (C).

3.78 (C)

Consultation : Act of referring for consulting.

Example : A **consultation** of several medical specialist.

Insinuation : The act of gaining acceptance or affection for yourself by persuasive and subtle blandishments.

Example : Very recently an **insinuation** was made that it was not the peoples movement which won freedom.

Culmination : A concluding action.

Example : As a **culmination** of this process, the president of South Africa, Mr. Cyril Ramaphosa visited India in January 2019 and was the chief guest at the Republic day parade.

Desperation : A state in which all hope is lost or absent.

Example : In **desperation** terrorist turned to action such as the large scale massacre of innocent civilians.

Hence, the correct option is (C).

3.79 (D)

The given sentence is pointing to some kind of imagination, hence the most appropriate word is 'pictured'.

Hence, the correct option is (D).

3.80 (A)

Killed **in** accidents and die **of** diseases.

∴ in, of are the correct phrasal verb for the sentence.

Hence, the correct option is (A)

3.81 (B)

The word 'Coup' means a sudden, illegal and often violent change of government and this situation will lead to sudden 'jump'; drop or fall of shares for which the appropriate word is 'plunged'

Hence, the correct option is (B).

3.82 (C)

To improve the output, increase in the level of production is required.

Hence, the correct option is (C).

3.83 (A)

Voracious = Engaging in an activity with great eagerness or enthusiasm.

Hence, the correct option is (A).

3.84 (B)

Since the sentence mentions 'but', therefore the blank will be the opposite in meaning of word 'excellent', i.e., extremely poor

Hence, the correct option is (B).

3.85 (B)

Despite is used as a preposition when a something happens even though it might have been prevented (i.e. in contrast).

∴ Opposite of poor performance is bright.
Hence, the correct option is (B).

3.86 (B)

Whom : Used to refer to the object of a verb or preposition.

Who : Used to refer to the subject of a sentence.

Which : Used in relative clause or when you have limited field to choose from.

Whose : Used when you're asking to whom something belongs.

Ex. Whose car is that?

Since, who refers to the subject.

Hence, the correct option is (B).

3.87 (A)

Easier : When the comparison is between two things we use second degree of an adjective.

More easy : (not appropriate)

Much easy : (Not appropriate)

Easiest : When the comparison is between more than two things, we use superlative degree of an adjective.

Getting to the top is easier than staying on top, here we are comparing between two things.

Hence, the correct options is (A).

3.88 (D)

(As - as) and (so-as) : are used in positive degree of adjective only

Worse, better : are comparative degree

Nicest : is superlative degree

Hence, the correct option is (D).

3.89 (A)

Fare : The amount of money you pay to travel by Bus, Train, Taxi, etc.

Fair : appropriate and acceptable in a particular situation.

The **fare** is too high for it to be considered **fair**.

Hence, the correct option is (A).

3.90 (A)

Given : A palindrome is a word that reads the same forward and backward.

In a game of words, a player has the two plates painted with letters A D

The player need to construct a five letter palindrome by using those given two letter plates.

The player should use all five plates exactly one and the plates can be rotated in their plane.

According to option A,

R V R

Can be used by rotating and combining with given letter plates.

The palindrome in a word will look like

R A D A R

That word will give same meaning either reads forward or backwards.

Hence, the correct option is (A).

3.91 (C)

Heal : to become healthy again.

Heel : the back part of your foot

In this question 'an injury to your' is given that means we need a body part that means 'heel' is correct.

So option (A) and (D) are eliminated and we need 'heal' in second filler.

Hence, the correct option is (C).

3.92 (B)

In option (A), "but not old age" is mentioned where in paragraph it is given that "it is never too early", so this option is eliminated.

In option (B), healthy eating in early is better for healthy aging is given which is directly related to paragraph. So this option is correct.

In option (C), there is a comparison between adult and kid is given where in the paragraph there is no such comparison is given. So this option is eliminated.

In option (D), nothing is given related to health conditions in the paragraph so we can't relate to this option and this option is also eliminated.

Hence, the correct option is (B).

3.93 (D)

Given : We reached the station late, and nearly missed the train.

Hence, the correct option is (D).

3.94 (B)

Given :

- (i) Once on the terrace, on her way to her small room in the corner, she notices the man right away.
- (ii) She begins to pant by the time she has climbed all the stairs.
- (iii) Mina has bought vegetables and rice at the market, so her bags are heavy.
- (iv) He was leaning against the parapet, watching the traffic below.

We will make pair of two sentence for the sequences which creates a coherent narrative.

The pairs will be (iii) and (ii) which gives a meaningful narrative in the same way (i) and (iv).

According to the options, sequence in option (B) will give best coherent meaning.

Hence, the correct option is (B).

3.95 (D)

Given : The country of Zombieland is in distress since more than 75% of its working population is suffering from serious health issues.

Studies conducted by competent health experts conducted that a complete lack of physical exercise among its working population was one of the leading cause of their health issues.

According to this information the government of Zombieland has to take action for the physical fitness of its working population.

So, they decided to provide monetary incentives to those who ride bicycles to work.

Therefore, we can say the government of Zombieland believes that riding bicycles is a form of physical exercise.

Hence, the correct option is (D).

3.96 (A)

Given : He did not manage to fix the car himself, so he got it fixed in the garage.

Hence, the correct option is (A).

3.97 (D)

Given : In a recently held parents teacher meeting, the teachers had very few complaints about Ravi. After all, Ravi was a hardworking and kind student. Incidentally, almost all of Ravi's friends at school were hard working and kind too. But the teachers drew attention to Ravi's complete lack of interest in sports. The teachers believed that along with some of his friends who shows similar disinterest in sports, Ravi needed to engage in some sports for his overall development.

Option (A) is not correct, as only some of Ravi's friend are hardworking and kind.

Option (B) is not correct, as almost all Ravi's friend are hardworking and kind.

Option (C) is not correct, as some of the Ravi's friend are interested in sports.

Option (D) is correct, as all of Ravi's friends are hardworking and kind.

Hence, the correct option is (D).

3.98 (C)

Given :

1. I could not bring myself to knock
2. There was a number of unfamiliar voices coming from the big drawing room and the door was firmly shut.
3. The passage was dark for a bit, but then it suddenly opened into a bright kitchen.
4. I decided I would rather wander down the passage.

We will make pair of two sentence for the sequences which creates a coherent narrative.

The pairs will be 2-1 and 4-3 which gives a meaningful narrative.

According to the options, sequence in option (C) will give best coherent meaning.

Hence, the correct option is (C).

3.99 (D)

Given : Rafi told Mary that he was thinking of watching a film this weekend.

Hence, the correct option is (D).

3.100 (D)

Given : Student of all department of a college who have successfully completed the registration process are eligible to vote in the upcoming college elections however by the time the due date of registration was over it was found that surprisingly none of the student from the department of human science had completed the registration process.

- (i) All those student who would not be eligible to vote in college election would certainly belong to the department of human science, cannot be inferred, as it is not a necessary condition or situation according to the given information.
- (ii) None of student from departments other than human science failed to complete

the registration process within the due time, cannot be inferred, as we have no information about the departments other than human science.

- (iii) All the eligible voters would certainly be students who are not from the human science, can be inferred logically with certainty, as according to the given information “it was found that surprisingly none of the student from the department of human science had completed the registration process.” So, all the eligible voters would not be from department of human science.

Hence, the correct option is (D).

3.101 (D)

Given : We tend to think of cancer as a ‘modern’ illness because its metaphors are so modern. It is a disease of overproduction, of sudden growth, a growth that is unstoppable, tipped into the abyss of no control. Modern cell biology encourages us to imagine the cell as a molecular machine. Cancer is that machine unable to quench its initial command (to grow) and thus transform into an indestructible, self-propelled automaton. From the given information we can clearly seen the modern cell biology uses figurative language, such as metaphors to describe modern illness cancer.

Hence, the correct option is (D).

3.102 (C)

Given : I cannot support this proposal. My_____ will not permit it.

Conscious : Aware of and responding to one’s surroundings awake.

Consensus : A general agreement

Conscience : An inner feeling or voice, viewed as acting as a guide to the rightness or wrongness of one’s behavior.

Consent : Permission for something to happen or agreement to do something as per the meanings of all wards the correct word which could be used is conscience by which the statement will be meaningful.

Hence, the correct option is (C).

3.103 (B)

Given : When I was a kid, I was partial to stories about other worlds and interplanetary travel. I used to imagine that I could just gaze off into space and be whisked to another planet.

As mentioned in the given passage “when I was a kid” it clearly indicates that it is an adult’s memory of what he or she liked as child by which option (B) can be inferred.

Hence, the correct option is (B).

3.104 (D)

Given : Residency is a famous housing complex with many well-established individuals among its residents. A recent survey conducted among the residents of the complex revealed that all of those residents who are well established in their respective fields happen to be academicians. From this information we can easily inferred that “Some academicians residing in the complex are well established in their fields” option (D) is correct.

Option (C) cannot be inferred with certainty as it is not a necessary condition some residents who are established in their field cannot be the authors of any book.

Option (B) can also not be inferred as it is clearly mention in the passage, all those residents who are well established in their respective field are academicians and vice-versa cannot be certainly inferred.

Option (A) can also not be inferred as “some authors of bestselling books are residents of the complex who are wells established in their

fields.” Are academicians which is not mention in option.

Hence, the correct option is (D).

3.105 (C)

Given :

- (i) The majority of human DNA has no rule in the synthesis of proteins can be inferred with certainty, as “the information contained in DNA is used to synthesis proteins is given in the passage. Apart from this there in no information in passage that how much part of human DNA has role in the synthesis of proteins.
- (ii) The function of about 98% of human DNA is not understood can be inferred with certainty as “DNA has coding and non-coding regions. Coding regions constitute only about 2% of human DNA” is given in the passage and we have no information about non-coding region of DNA in the passage.

Hence, the correct option is (C).

3.106 (C)

Given : “I have not yet decided, what will I do this evening; I might visit a friend”.

Hence, the correct option is (C).

3.107 (D)

Given : The James Webb telescope, recently launched in space, is giving humankind unprecedented access to the depths of time by imaging very old stars formed almost 13 billion years ago. Astrophysicists and cosmologists believe that this odyssey in space may even shed light on the existence of dark matter. Dark matter is supposed to interact only via the gravitational interaction and not through the electromagnetic-, the weak- or the strong-interaction. This may justify the epithet “dark” in dark matter.

According to the given paragraph statement in option (D) is FALSE.

As, “Dark matter is supposed to interact only via the gravitational interaction and not through the electromagnetic-, the weak- or the strong-interaction.”

Hence, the correct option is (D).

3.108 (D)

Given : Elvesland is a country that has peculiar beliefs and practices. They express almost all their emotions by gifting flowers. For instance, if anyone gifts a white flower to someone, then it is always taken to be a declaration of one’s love for that person. In a similar manner, the gifting of a yellow flower to someone often means that one is angry with that person.

- (i) In Elvesland, one always declares one’s love by gifting a white flower cannot be inferred with certainty, as gifting white flower is sign of declaration of ones love for the person. It is not declares by a person.
- (ii) In Elvesland, all emotions are declared by gifting flowers cannot be inferred with certainty, as they express “almost all” their emotions by gifting flowers. Therefore “All” (definite) cannot be true.
- (iii) In Elvesland, sometimes one expresses one’s anger by gifting a flower that is not yellow is definitely cannot inferred as the gifting of a yellow flower to someone often means that one is angry with that person.
- (iv) In Elvesland, sometimes one expresses one’s love by gifting a white flower can be inferred with certainty, as if anyone gifts a white flower to someone, then it is always taken to be a declaration of one’s love for that person.

Hence, the correct option is (D).

3.109 (D)

Given : When the congregation sang together, Apenyo would also join, though her little screams were not quite audible because of the group singing. But whenever there was a special number, trouble would begin; Apenyo would try singing along, much to the embarrassment of her mother. After two or three such mortifying Sunday evenings, the mother stopped going to church altogether until Apenyo became older and learnt to behave.

At home too, Apenyo never kept quiet; she hummed or made up silly songs to sing by herself, which annoyed her mother at times but most often made her become pensive. She was by now convinced that her daughter had inherited her love of singing from her father who had died unexpectedly away from home.

Option (A) cannot be inferred as her mother was embarrassed about her daughter's singing at church.

Option (B) cannot be inferred as the mothers feelings about her daughter's singing at home were not only of annoyance but also she become pensive.

Option (C) cannot be inferred as she was convinced that her daughter had inherited her love of singing from her father.

Option (D) can be inferred as when open go hummed at home, her mother tended to become thought-full and then convinced.

Hence, the correct option is (D).

3.110 (B)

Given : You are delaying the completion of the task. Send your contributions at the earliest.

Hence, the correct option is (B).

3.111 (D)

Given : In 2022, June Huh was awarded the Fields medal, which is the highest prize in Mathematics.

When he was younger, he was also a poet. He did not win any medals in the International Mathematics Olympiads. He dropped out of college.

Option (A) and option (B) cannot be inferred, as we have information only for Huh and not for every field medalist.

Option (C) cannot be inferred, as we have no information about all field medalist.

Option (D) can be certainly inferred, as it is stated that Huh is awarded the Fields medal and also he dropped out of college, so we can inferred some field medalists have dropped out of collage.

3.112 (C)

Given : The World Bank has declared that it does not plan to offer new financing to Sri Lanka, which is battling its worst economic crisis in decades, until the country has an adequate macroeconomic policy framework in place. In a statement, the World Bank said Sri Lanka needed to adopt structural reforms that focus on economic stabilization and tackle the root causes of its crisis. The latter has starved it of foreign exchange and led to shortages of food, fuel, and medicines. The bank is repurposing resources under existing loans to help alleviate shortages of essential items such as medicine, cooking gas, fertilizer, meals for children, and cash for vulnerable households.

Option (C) can be inferred with certainty. As the given information in passage. The World Bank has declared that it does not plan to offer new financing to Sri Lanka, which is battling its worst economic crisis in de-codes, until the country has

an adequate macroeconomic policy framework in place.

According this info, Sri-Lanka does not yet have an adequate macroeconomic policy framework. Hence, the correct option is (C).

3.113 (A)

Given :

If → denotes increasing order of intensity.

[talk → shout → scream]

From option (A) :

flatter : To praise someone in order to make them feel attractive or important. Sometime in a way that is not sincere.

Note : Pander and flatter are semantically related in same cases you can use pander instead a verb flatter.

Hence option (A) is correct.

From option (B) :

flutter : To move or make something move quickly and lightly especially through the air

Hence, option (B) is incorrect.

From option (C) :

fritter : Can be both a Noun and a verb. As a Noun it refers to a small piece of food. Such as fruit meat or vegetables that is coated in batter and fried until crisp. As a verb. It means to waste time, money or energy on trifling matters or activities that have little or no value.

Hence option (C) is incorrect.

From option (D) :

frizzle : To become or make something crisp (Pleasantly dry and hard) or slightly burned by frying or grilling.

Hence option (D) is incorrect.

Hence, the correct option is (A).

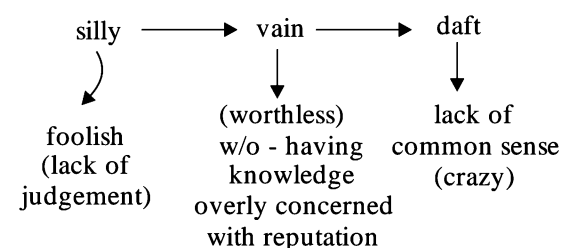
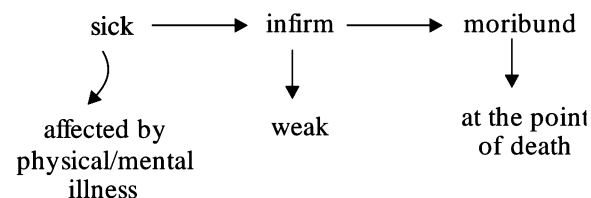
3.114 (D)

In the context, the word choices should (D) align with the tense and subject-verb agreement the correct option is (D).

Where "holds" (i) matches the singular subject "athletics". "waits" (ii) agrees with the singular "crowd", "culminate" (iii) fits the sequence, and "pivots" (iv) corresponds to the action of the body.

Hence, the correct option is (D).

3.115 (D)



Hence, the correct option is (D).

3.116 (D)

Given : Had I learnt acting as a child,

I _____ a famous film star.

- (i) The sentence is a third conditional (Hypothetical past situation and its possible result).
- (ii) Has I learnt acting as a child : (This is a past unreal condition)
- (iii) The result clause should also be in the past unreal form, which is could have been (Indicating a missed possibility in the past).

Thus the correct sentence is :

“Had I learnt acting as a child, I could have been a famous film star.”

Hence, the correct option is (D).

3.117 (D)

Given : Kavya _____ go to work yesterday as she _____ Felling well

- (i) The sentence is in the past tense, so we need past tense forms
- (ii) Couldn't is the best choice because it correctly conveys that she was unable to go to work due to not feeling well.
- (iii) Wasn't is the best choice because it correctly states that she was not feeling well in the past.

Hence, the correct option is (D).

3.118 (C)

From option (A) : Ambivalence means doubt, so it doesn't fit.

From option (B) : Satisfaction means being happy, which is not related.

From option (C) : Resolve means strong determination, which matches the sentence's meaning.

From option (D) : Revolve means to turn around, which makes no sense here.

So, "Rehman's resolve never wavered" is the best choice.

Hence, the correct option is (C).

3.119 (D)

The phrase "on television" is the correct idiomatic usage when referring to something being broadcast.

From option (A) : in - Incorrect because we do not use "in" for television broadcasts. "In" is generally used for enclosed spaces (e.g., "in a box," "in a room"), but television is not an enclosed medium; it is a broadcasting platform.

From option (B) : at - Incorrect because "at television" is not a proper collocation in English. "At" is usually used for locations or points in time (e.g., "at school," "at 5 PM"), which does not fit this context.

From option (C) : within - Incorrect because "within" suggests something inside a confined space or within limits (e.g., "within a building,"

"within reach"), which does not apply to television.

From option (D) : on - Correct, because we say "on television" to refer to shows being broadcast on TV.

Example : "The match is on television tonight."

The correct sentence is :

Is there any good show on television tonight?

Hence, the correct option is (D).

3.120 (D)

The word "summarily" means "immediately and without a lengthy process or formalities." When a person is dismissed summarily, it means they were fired without much discussion or procedural delays, often as a result of a serious offense like embezzlement.

From option (A) : Sumptuously - Incorrect because "sumptuously" means "lavishly" or "richly," which does not make sense in the context of dismissal. Example: "The guests were treated sumptuously at the banquet."

From option (B) : Brazenly - Incorrect because "brazenly" means "boldly and without shame." While it could describe how someone acts, it does not describe the manner of dismissal. Example: "He brazenly lied in court."

From option (C) : Unintentionally - Incorrect because dismissals are intentional acts. "Unintentionally" means "without meaning to," which does not fit because firing someone is a deliberate decision. Example: "She unintentionally spilled the coffee."

From option (D) : Summarily - Correct, because it means "without delay or ceremony," which fits the context of an immediate dismissal for misconduct. Example: "He was summarily dismissed for violating company policies."

The correct sentence is :

As the police officer was found guilty of embezzlement, he was summarily dismissed from the service in accordance with the Service Rules.

Hence the correct option is (D).

3.121 (B)

Column – I		Column-II	
P.	This house is in a mess.	1.	Alright, I won't bring it up during our conversations.
Q.	I am not happy with the marks given to me.	2.	Well, you can easily look it up.
R.	Politics is a subject I avoid talking about.	3.	No problem, let me clear it up for you.
S.	I don't know what this word means.	4.	Don't worry, I will take it up with your teacher.

Let us match each statement logically with the appropriate response.

- (i) **P :** "This is in a mass"
- A logical response would be "No problem, let me clear it up for you."
- (ii) **Q :** "I am not happy with the marks given to me."
- A logical response would be "Don't worry I will take it up with your teacher."
- (iii) **R :** "Politics is a subject I avoid talking about."
- A logical response would be "Alright I won't bring it up during our conversations."
- (iv) **S :** "I don't know what this world means."

- A logical response would be "Well you can easily look it up."

$$P \rightarrow 3, Q \rightarrow 4, R \rightarrow 1, S \rightarrow 2$$

Hence, the correct option is (B).

3.122 (A)

This is a word puzzle based on four clues. Let's identify the keywords :

Clue 1 : Synonym of recognize (8 letters) : _ D _ N T _ F Y

Keyword : IDENTIFY (Start with I)

Clue 2 : A story long enough to fill a book (5 letters) : _ _ _ E L

Keyword : NOVEL (Starts with N)

Clue 3 : Two of something (6 letters) : _ _ _ P L E

Keyword : COUPLE (Starts with C)

Clue 4 : A fraction of something, split equally into two parts (4 letters) : _ _ _ F

Keyword : HALF (Starts with H)

The Final Word :

The first letters of the keywords are I, N, C, H. Rearranging these letters (I, N, C, H) forms the word CHIN.

Hence, the correct option is (A).

3.123 (C)

- (A) score; despite: Incorrect tense ("score" is present).
- (B) scoring; instead of: Incorrect grammar ("scoring" lacks a helper verb) and "instead of" implies they chose scoring over rain, which doesn't make sense.
- (C) scored; despite: Correct. "Scored" matches the past tense of "needed," and "despite" correctly shows the contrast with the rain.
- (D) scoring; in spite of: Incorrect grammar ("scoring" lacks a helper verb).

Hence, the correct option is (C).

3.124 (B)

an elephant

Hence, the correct option is (B).

3.125 (B)

A protagonist is the leading figure or main character in a story.

The opposite of this is an antagonist, the character who opposes the protagonist.

Hence, the correct option is (B).

3.126 (A)

Exaggerating numbers leads to false claims, and honesty is what gives rise to (engenders) trust.

Hence, the correct option is (A).

3.127 (B)

Verbosity means too many words

Brevity means few words

Insolence means rude

Verbosity & Brevity are antonyms thus respect is the answer.

Hence, the correct option is (B).

3.128 (A)

All three words given Expedite, Hasten, Hurry, mean to make something happen faster.

- Accelerate - Means to speed up
- Retard - Means to delay
- Provide - Means to give
- Disable - Means to make unable

Hence, the correct option is (A).

3.129 (A)

My friend and I parted at the door of the cabin that I had rented for the night"

Hence, the correct option is (A).



4

Idioms & Phrases

2013 IIT Bombay

4.1 Statement : You can always give me a ring whenever you need.

Which one of the following is the best inference from the above statement?

[EC, EE, IN]

- (A) Because I have a nice caller tune.
- (B) Because I have a better telephone facility.
- (C) Because a friend in need is a friend indeed.
- (D) Because you need not pay towards the telephone bills when you give me a ring.

4.2 Statement : There were different streams of freedom movements in colonial India carried out by the moderates, liberals, radicals, socialists, and so on.

Which one of the following is the best inference from the above statement?

[EC, EE, IN]

- (A) The emergence of nationalism in colonial India led to our Independence.
- (B) Nationalism in India emerged in the context of colonialism.
- (C) Nationalism in India is homogeneous.
- (D) Nationalism in India is heterogeneous.

4.3 Mahatma Gandhi was known for his humility as

[AE, AG, BT, CH, CY, MN, XE, XL]

- (A) he played an important role in humiliating exit of British from India.
- (B) he worked for humanitarian causes.
- (C) he displayed modesty in his interactions.
- (D) he was a fine human being.

2014 IIT Kharagpur

4.4 Which of the options given below best completes the following sentence?

She will feel much better if she _____.

[EC-2, ME-2]

- (A) will get some rest
- (B) gets some rest
- (C) will be getting some rest
- (D) is getting some rest

4.5 “India is a country of rich heritage and cultural diversity.”

Which one of the following facts best supports the claim made in the above sentence? [EC-3, ME-3]

- (A) India is a union of 28 states and 7 union territories.
- (B) India has a population of over 1.1 billion.
- (C) India is home to 22 official languages and thousands of dialects.

- (D) The Indian cricket team draws players from over ten states.
- 4.6 Which of the following options is the closest in meaning to the phrase underlined in the sentence below?
- It is fascinating to see life forms cope with varied environmental conditions.

[CS-1, EE-1]

- (A) adopt to (B) adapt to
(C) adept in (D) accept with
- 4.7 In a press meet on the recent scam, the minister said, "The buck stops here" what did the minister convey by the statement?

[CS-1, EE-1]

- (A) He wants all the money
(B) He will return the money
(C) He will assume final responsibility
(D) He will resist all enquiries
- 4.8 Choose the most appropriate phrase from the options given below to complete the following sentence :

India is post-colonial country because

[CS-2, EE-2]

- (A) It was a former British colony.
(B) Indian information Technology professionals have colonized the world.
(C) India does not follow any colonial practices.
(D) India has helped other countries gain freedom.

- 4.9 While trying to collect an envelope

I

from under the table, Mr. X fell down

II

III

and was losing consciousness.

IV

Which one of the above underlined parts of the sentence is NOT appropriate?

[CS-3, EE-3]

- (A) I (B) II
(C) III (D) IV

- 4.10 Which of the following options is the closest in meaning to the sentence below?

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

"As a woman, I have no country."

- (A) Women have no country.
(B) Women are not citizens of any country.
(C) Women's solidarity knows no national boundaries.
(D) Women of all countries have equal legal rights.

2015

IIT Kanpur

- 4.11 Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence :

Frogs _____.

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]

- (A) croak (B) roar
(C) hiss (D) patter

- 4.12 The following question presents a sentence, part of which is underlined. Beneath the sentence you find four ways of phrasing the underlined part. Following the requirements of the standard written English, select the answer that produces the most effective sentence.

Tuberculosis, together with its effects, ranks one of the leading causes of death in India.

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]

- (A) ranks as one of the leading causes of death.
 (B) rank as one of the leading causes of death.
 (C) has the rank of one of the leading causes of death.
 (D) are one of the leading causes of death.
- 4.13 Humpty Dumpty sits on a wall every day while having lunch. The wall sometimes breaks. A person sitting on the wall falls if the wall breaks.**
 Which one of the statements below is logically valid and can be inferred from the above sentences?
[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]
 (A) Humpty Dumpty always falls while having lunch.
 (B) Humpty Dumpty does not fall sometimes while having lunch.
 (C) Humpty Dumpty never falls during dinner.
 (D) When Humpty Dumpty does not sit on the wall, the wall does not break.
- 4.14 Choose the most suitable one word substitute for the following expression :
 Connotation of a road or way**
[EC-3, ME-2]
 (A) Pertinacious (B) Viaticum
 (C) Clandestine (D) Ravenous
- 4.15 Which of the following options is the closest in meaning to the sentence below?**
She enjoyed herself immensely at the party. **[CS-1, EE-1]**
 (A) She had a terrible time at the party.
 (B) She had a horrible time at the party.
 (C) She had a terrific time at the party.
 (D) She had a terrifying time at the party.
- 4.16 Select the alternative meaning of the underlined part of the sentence.**
The chain snatchers took to their heels when the police party arrived.
[CS-1, EE-1]
 (A) took shelter in a thick jungle.
 (B) open indiscriminate fire.
 (C) took to flight.
 (D) unconditionally surrendered.
- 4.17 Choose the statement where underlined word is used correctly.** **[CS-2, EE-2]**
 (A) The industrialist had a personnel jet.
 (B) I write my experience in my personnel diary.
 (C) All personnel are being given the day off.
 (D) Being religious is a personnel aspect.
- 4.18 A generic term that includes various items of clothing such as a skirt, a pair of trousers and a shirt is** **[CS-2, EE-2]**
 (A) fabric (B) textile
 (C) fibre (D) apparel
- 4.19 Fill in the blank with the correct idiom/phrase.**
That boy from the town was a _____ in the sleepy village.
[AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]
 (A) Dog out of herd
 (B) Sheep from the heap
 (C) Fish out of water
 (D) Bird from the flock
- 4.20 Choose the statement where underlined word is used correctly.**
[AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]
 (A) When the teacher eludes to different authors, he is being elusive.

- (B) When the thief keeps eluding the police, he is being elusive.
- (C) Matters that are difficult to understand, identify or remember are allusive.
- (D) Mirages can be allusive, but a better way to express them is illusory.
- 4.21** Select the appropriate option in place of underlined part of the sentence.
Increased productivity necessary reflects greater efforts made by the employees.
 [AE, GG, IN, MA, ME-3, MN, MT, PH, PI, TF]
- (A) Increase in productivity necessary
 (B) Increase productivity is necessary
 (C) Increase in productivity necessarily
 (D) No improvement required

2016 IISc Bangalore

- 4.22** After India's cricket world cup victory in 1985, Shrotria who was playing both tennis and cricket till then, decided to concentrate only on cricket. And the rest is history.
 What does the underlined phrase mean in this context? [EC-2, ME-3]
- (A) history will rest in peace
 (B) rest is recorded in history books
 (C) rest is well known
 (D) rest is archaic
- 4.23** Nobody knows how the Indian cricket team is going to cope with the difficult and seamer-friendly wickets in Australia. Choose the option which is closest in meaning to the underlined phrase in the above sentence. [CS-2, EE-1]
- (A) put up with (B) put in with
 (C) put down to (D) put up against

- 4.24** All hill-stations have a lake. Ooty has two lakes.

Which of the statement(s) below is/are logically valid and can be inferred from the above sentences? [CS-2, EE-1]

- (i) Ooty is not a hill-station.
 (ii) No hill-station can have more than one lake.
- (A) (i) only
 (B) (ii) only
 (C) both (i) and (ii)
 (D) neither (i) nor (ii)
- 4.25** R2D2 is a robot. R2D2 can repair aeroplanes. No other robot can repair aeroplanes. [AE, EE-2, TF, XE, XL]
- Which of the following can be logically inferred from the above statements?

- (A) R2D2 is a robot which can only repair aero planes.
 (B) R2D2 is the only robot which can repair aero planes.
 (C) R2D2 is a robot which can repair only aero planes.
 (D) Only R2D2 is a robot.

- 4.26** He turned a deaf ear to my request.

What does the underlined phrasal verb mean? [AG, CE-2, EY, MT, PI]

- (A) Ignored (B) Appreciated
 (C) Twisted (D) Returned

2017 IIT Roorkee

- 4.27** She has a sharp tongue and it can occasionally turn

[BT, CY, EC-1, EY, PI]

- (A) hurtful (B) left
 (C) methodical (D) vital

2020 IIT Delhi

- 4.28** He is known for his unscrupulous ways. He always sheds _____ tears to deceive people.

[IN, ME-1, MT, PE, PH]

- (A) Crocodile (B) Fox's
(C) Fox (D) Crocodile's

- 4.29** I do not think you know the case well enough to have opinions. Having said that, I agree with your other point. What does the phrase "having said that" mean in the given text?

[IN, ME-1, MT, PE, PH]

- (A) As opposed to what I have said
(B) Despite what I have said
(C) Contrary to what I have said
(D) In addition to what I have said

- 4.30** In one of the greatest innings ever seen in 142 years of the Test history, Ben Stokes upped the tempo in a five-and-a-half hour long stay of 219 balls including 11 fours and 8 sixes that saw him finish on a 135 not out as England squared the five-match series. Based on their connotations in the given passage, which one of the following meanings DOES NOT match?

[CY, ME-2, PI]

- (A) upped = increased
(B) squared = lost
(C) saw = resulted in
(D) tempo = enthusiasm

- 4.31** It is a common criticism that most of the academicians live in their _____, so, they are not aware of the real life challenges. [CE-1]

- (A) glass palaces (B) homes
(C) big flats (D) ivory towers

Answers

Idioms & Phrases

4.1	C	4.2	D	4.3	C	4.4	B	4.5	C
4.6	B	4.7	C	4.8	A	4.9	D	4.10	C
4.11	A	4.12	A	4.13	B	4.14	B	4.15	C
4.16	C	4.17	C	4.18	D	4.19	C	4.20	B
4.21	C	4.22	C	4.23	A	4.24	D	4.25	B
4.26	A	4.27	A	4.28	A	4.29	B	4.30	B
4.31	D								

Explanations

Idioms & Phrases

4.1 (C)

“You can always give me a ring whenever you need.”

This statement, means that whenever there is any problem or need, feel free to call me. It simply means “a friend is need is a friend indeed.”

Hence, the correct option is (C).

4.2 (D)

In the above statement, the movement in colonial India is carried out by different persons of different philosophies.

For example, some are moderates, some are liberals, etc. Therefore, different philosophies shows heterogeneous character. Hence, Nationalism in India is heterogeneous.

Hence, the correct option is (D).

4.3 (C)

Humility : Quality of being humble or modest.

Mahatma Gandhi was known for his humility as he displayed modesty in his interactions.

Hence, the correct option is (C).

4.4 (B)

If two events in the future is being talked about then the sentence starting with ‘if’ takes simple present tense and the other sentence takes simple future tense.

Hence, the correct option is (B).

4.5 (C)

Only in option (C), actual diversity is shown in terms of different languages.

Hence, the correct option is (C).

4.6 (B)

‘Cope with’ means to **adapt to** which means adjust to something.

Adopt to : Take legally.

Adept in : Skillful or Skilful.

Accept with : Agree.

Hence, the correct option is (B).

4.7 (C)

‘The buck stops here’ means that responsibility for something should not be passed to someone else i.e. assume the final responsibility.

Hence, the correct option is (C).

4.8 (A)

Post-colonial : Existing after the end of colonial rule.

Since, British ruled India, it can be said that India is a post-colonial country because it was a former British colony.

Hence, the correct option is (A).

4.9 (D)

The statement clearly says that ‘while trying to collect an envelope from under the table, Mr. X

fell down' which is in past tense. The statement continues with 'and' so the rest of the part of the sentence should also be in past tense (and lost consciousness). Therefore, part (IV) of the sentence is incorrect.

Hence, the correct option is (D).

4.10 (C)

Given : "As a woman, I have no country."

Given statement is used as a metaphor to illustrate that women of all countries are united and their union is not affected by the fact that they belong to different countries.

Option (C) relates to given statement perfectly.

[Solidarity means unity or harmony]

In option (A), literal meaning of given statement is taken which is wrong.

In option (B), the statement is factually incorrect as well as does not relate to anywhere near the given statement because the statement in the question does not comment about citizenship.

In option (D), it is stated that women of all countries have equal legal rights.

Given statements in the question does not refer to anything remotely related to legal rights of women.

Hence, the correct option is (C).

4.11 (A)

The sound made by Frog is croak.

Hence, the correct option is (A).

4.12 (A)

Tuberculosis is a singular noun so option (D) is incorrect and the word 'rank' should be followed by 's'. So, option (B) is incorrect.

'has the rank of one' is grammatically incorrect.

So, option (C) is also incorrect.

Hence, the correct option is (A).

4.13 (B)

From option (A) : Humpty Dumpty always falls while having lunch.

Since the wall breaks sometimes, Humpty Dumpty can not always fall while having lunch. Hence, option (A) is incorrect.

From option (C) : Humpty Dumpty never falls during dinner.

There is nothing mentioned about dinner in the given passage. So, we can not comment on that therefore option (C) is inappropriate.

From option (D) : When Humpty Dumpty does not sit on the wall, the wall does not break.

It is not clearly mentioned that why, when or how the wall breaks so option (D) is also inappropriate.

From option (B) : Humpty Dumpty does not fall sometimes while having lunch.

'The wall sometimes breaks', here sometimes is the keyword. It is clear that sometimes the wall breaks and sometimes it does not which means sometimes Humpty Dumpty does not fall while having lunch.

Hence, the correct option is (B).

4.14 (B)

Connotation : A feeling or idea that is suggested by a particular word.

Pertinacious : Determined, firm, strong, resolute.

Viaticum : Provisions for a journey.

Clandestine : Secret, confidential, latent.

Ravenous : Very hungry, predatory, vultures.

Hence, the correct option is (B).

4.15 (C)

The phrase "enjoyed herself immensely" means she had a fantastic or terrific time.

Hence, the correct option is (C).

4.16 (C)

"Took to their heels" is an idiom which means running away or "took to flight".

Hence, the correct option is (C).

4.17 (C)

Personnel : A person or a group of people employed in an organization or place of work.

Personal : Relating to a particular person or individual.

Only in the statement in option (C) word personnel is used appropriately.

Hence, the correct option is (C).

4.18 (D)

Fabric : A cloth made by weaving or knitting fibres.

Textile : Any cloth or goods produced by weaving or knitting.

Fibre : A fine, threadlike piece, as of cotton, jute or asbestos.

Apparel : A garment, clothing especially outerwear or attire.

Hence, the correct option is (D).

4.19 (C)

Dog out of herd : This phrase refers to someone who is out of his/her group.

[Herd : Large group of animal]

Sheep from the heap : This phrase does not hold any specific correct meaning.

[Heap : Stack, bundle]

Fish out of water : This idiom refers to being uncomfortable in an unknown environment.

Bird from the flock : This phrase refers to someone who belongs to their respective group.

[Flock : Large group of birds or animals]

Given sentence in the question means the boy is from town, so he feels uncomfortable in the village.

Hence, the correct option is (C).

4.20 (B)

Elude : Escaping from or avoiding danger.

Elusive : Difficult to catch, find or achieve.

Allusive : Implying or indirectly suggesting something.

‘When the thief keeps eluding the police’ means when the thief is escaping from police again and again. ‘He is being elusive’ means he is hard to catch.

Hence, the correct option is (B).

4.21 (C)

Necessary : Adjective

Necessarily : Adverb

Adverb always gives extra information about the verb and adjective gives extra information about the noun.

Here in the question great effort is necessarily reflected by increase in productivity.

Adverb ‘Necessarily’ is giving extra information that great efforts are the main reason to reflect (verb) increase in productivity.

Hence, the correct option is (C).

4.22 (C)

Archaic : Very old fashion

The underlined phrase means that rest is well known. As history is permanent documentation and well known.

Hence, the correct option is (C).

4.23 (A)

“cope with” means to put up with or tolerate.

Hence, the correct option is (A).

4.24 (D)

Given statements do not clearly indicate whether Ooty is a hill-station or not because having lakes does not necessarily mean Ooty is a hill-station. Hence, statement (i) can not be logically inferred.

Statement (ii) is also not true, because in given sentences, for a place to be a hill-station, at least one lake is compulsory but nothing is mentioned about how many number of lakes.

Hence, the correct option is (D).

4.25 (B)

The statement 'No other robot can repair aero planes' means R2D2 is the only robot which can repair aero planes and is the best inference drawn.

Hence, the correct option is (B).

4.26 (A)

'Turning a deaf ear' means ignoring someone.

Hence, the correct option is (A).

4.27 (A)

Hurtful means causing pain or suffering or something that is damaging or harmful. The expression "sharp tongue" defines a bitter or critical or rude manner of speaking.

Hence, the correct option is (A).

4.28 (A)

The idiom 'crocodile tears' refers to tears or expression of sorrow that are insincere.

Hence, the correct option is (A).

4.29 (B)

The speaker, while criticizing the listener, concedes that the listener does have one valid point of view.

Having said that : Despite what one has said.

Hence, the correct option is (B).

4.30 (B)

In the given passage, "squared" refers to victory or completing a task successfully,

∴ "Squared = Lost" does not matches with the passage.

Hence, the correct option is (B).

4.31 (D)

To live or be in **ivory tower** means to be unknown about or to want to be separated with the ordinary and unpleasant things that happen in people's real life.

Hence, the correct option is (D).



5

Grammar

2012 IIT Delhi

- 5.1 One of the parts (A, B, C, D) in the sentence given below contains an ERROR. Which one of the following is INCORRECT?

I requested that he should be given the driving test today instead of tomorrow.

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) requested that
(B) should be given
(C) the driving test
(D) instead of tomorrow
- 5.2 Choose the most appropriate alternative from the options given below to complete the following sentence :

If the tired soldier wanted to lie down, he _____ the mattress out on the balcony.

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) should take
(B) shall take
(C) should have taken
(D) will have taken
- 5.3 Choose the grammatically CORRECT sentence :

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) Two and two add four.
(B) Two and two become four.
(C) Two and two are four.
(D) Two and two make four.

- 5.4 Complete the sentence :

[CY, EC, EE, IN, MA, MT, XE, XL]

Dare _____ mistakes

- (A) commit (B) to commit
(C) committed (D) committing

- 5.5 Choose the grammatically **incorrect** sentence :

[BT, CE, CH, CS, ME, PH, PI]

- (A) They gave us the money back less the service charges of Three Hundred rupees.
(B) This country's expenditure is not less than that of Bangladesh.
(C) The committee initially asked for the funding of Fifty Lakh rupees, but later settled for a lesser sum.
(D) This country's expenditure on educational reforms is very less.

- 5.6 Choose the grammatically **CORRECT** sentence: [AR, GG, TF]

- (A) He laid in bed till 8 o'clock in the morning.
(B) He layed in bed till 8 o'clock in the morning.
(C) He lain in bed till 8 o'clock in the morning.
(D) He lay in bed till 8 o'clock in the morning.

- 5.7 Which one of the parts (A, B, C, D) in the sentence contains an **ERROR**?

No sooner had the doctor seen the results of the blood test, than he suggested the patient to see the specialist. [AR, GG, TF]

- (A) no sooner had
(B) results of the blood test
(C) suggested the patient
(D) see the specialist

2013 IIT Bombay

5.8 The Headmaster _____ to speak to you.

Which of the following options is incorrect to complete the above sentence?

[AE, AG, BT, CH, CY, MN, XE, XL]

- (A) is wanting (B) wants
(C) want (D) was wanting

5.9 All engineering students

I
should learn mechanics,

II
mathematics and how to do computation.

III IV
Which of the above underlined parts of the sentence is not appropriate?

[AE, AG, BT, CH, CY, MN, XE, XL]

- (A) I (B) II
(C) III (D) IV

5.10 The professor ordered to

I II
the students to go out of the class.

III IV
Which of the above underlined parts of the sentence is grammatically incorrect?

[AR, CE, GG, MA, MT, PH, TF]

- (A) I (B) II
(C) III (D) IV

5.11 Were you a bird, you _____ in the sky. [CS, ME, PI]

- (A) Would fly
(B) Shall fly
(C) Should fly
(D) Shall have flown

5.12 Choose the grammatically **incorrect** sentence : [CS, ME, PI]

- (A) He is of Asian origin.
(B) They belonged to Africa.
(C) She is an European.
(D) They migrated from India to Australia.

2014 IIT Kharagpur

5.13 Choose the most appropriate phrase from the options given below to complete the following sentence.

The aircraft _____ take off as soon as its flight plan was filed.

[EC-1, ME-1]

- (A) is allowed to
(B) will be allowed to
(C) was allowed to
(D) has been allowed to

5.14 Choose the most appropriate word from the options given below to complete the following sentence.

Communication and interpersonal skills are _____ important in their own ways. [EC-2, ME-2]

- (A) each (B) both
(C) all (D) either

5.15 'Advice' is _____. [EC-3, ME-3]

- (A) a verb.
(B) a noun.
(C) an adjective.
(D) both a verb and a noun.

5.16 Who _____ was coming to see us this evening? [CS-2, EE-2]

- (A) you said (B) did you say
(C) did you say that (D) Had you said

- 5.17 If she _____ how to calibrate the instrument, she _____ done the experiment. [CS-3, EE-3]

(A) knows, will have
(B) knew, had
(C) had known, could have
(D) should have known, would have

- 5.18 Choose the most appropriate word from the options given below to complete the following sentence.

A person suffering from Alzheimer's disease _____ short-term memory loss. [AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

(A) Experienced
(B) Unexperienced
(C) Is experiencing
(D) Experiences

2015 IIT Kanpur

- 5.19 Choose the appropriate word/phase, out of the four options given below, to complete the following sentence :

Dhoni, as well as the other team members of the Indian team _____ present on the occasion.

[EC-2, ME-1]

(A) were (B) was
(C) has (D) have

- 5.20 What is the adverb for the given word below? [EC-2, ME-1]

Misogynous

(A) Misogynousness (B) Misogynity
(C) Misogynously (D) Misogynous

- 5.21 In the following sentence certain parts are underlined and marked *P*, *Q* and *R*. One of the parts may contain certain error or may not be acceptable in standard written communication. Select the part

containing an ERROR. Choose D as your answer if there is NO ERROR.

[EC-2, ME-1]

The student corrected all the errors that *P*
the instructor marked on the *Q*
answer book *R*.

(A) *P* (B) *Q*
(C) *R* (D) No Error

- 5.22 Choose the correct verb to fill in the blank below : [EC-3, ME-2]

Let us _____.

(A) introvert (B) alternate
(C) atheist (D) altruist

- 5.23 Choose the most appropriate word from the options given below to complete the following sentence.

If the athlete had wanted to come first in the race, he _____ several hours every day. [EC-3, ME-2]

(A) should practice
(B) should have practiced
(C) practiced
(D) should be practicing

- 5.24 Ram and Shyam shared a secret and promised to each other that it would remain between them. Ram express himself in one of the following ways as given in the choices below. Identify the correct way as per standard English.

[EC-3, ME-2]

(A) It would remain between you and me.
(B) It would remain between I and you.
(C) It would remain between you and I.
(D) It would remain with me.

- 5.25** Out of the following four sentences, select the most suitable sentence with respect to grammar and usage :

[CS-2, EE-2]

- (A) Since the report lacked needed information, it was of no use to them.
 (B) The report was useless to them because there were no needed information in it.
 (C) Since the report did not contain the needed information, it was not real useful to them.
 (D) Since the report lacked needed information, it would not had been useful to them.

- 5.26** Choose the most appropriate word from the options given below to complete the following sentence.

The official answered _____ that the complaints of the citizen would be looked into. [CE-2]

- (A) respectably (B) respectfully
 (C) reputably (D) respectively

- 5.27** Choose the statement where underlined word is used correctly [CE-2]

- (A) The minister insured the victims that everything would be all right.
 (B) He ensured that the company will not have to bear any loss.
 (C) The actor got himself ensured against any accident.
 (D) The teacher insured students of good results.

2016 IISc Bangalore

- 5.28** Which of the following is **CORRECT** with respect to grammar and usage?

Mount Everest is _____.

[EC-1, ME-1]

- (A) the highest peak in the world.
 (B) highest peak in the world.
 (C) one of highest peak in the world.
 (D) one of the highest peak in the world.

- 5.29** The policeman asked the victim of a theft, "What did you _____?"

[EC-1, ME-1]

- (A) loose (B) lose
 (C) loss (D) louse

- 5.30** Based on the given statements, select the appropriate option with respect to grammar and usage. [EC-2, ME-3]

Statements :

- (i) The height of Mr. X is 6 feet.
 (ii) The height of Mr. Y is 5 feet.
 (A) Mr. X is longer than Mr. Y.
 (B) Mr. X is more elongated than Mr. Y.
 (C) Mr. X is taller than Mr. Y.
 (D) Mr. X is lengthier than Mr. Y.

- 5.31** An apple costs Rs. 10. An onion costs Rs. 8. Select the most suitable sentence with respect to grammar and usage.

[AR, CY, EC-3, IN, MA, PE]

- (A) The price of an apple is greater than an onion.
 (B) The price of an apple is more than onion.
 (C) The price of an apple is greater than that of an onion.
 (D) Apples are more costlier than onions.

- 5.32** Identify the correct spelling out of the given options : [AE, EE-2, TF, XE, XL]

- (A) Managable (B) Manageable
 (C) Mangaible (D) Managible

- 5.33** Out of the following four sentences, select the most suitable sentence with respect to grammar and usage.

[CE-1, CS-1]

- (A) I will not leave the place until minister does not meet me.
 (B) I will leave the place until the minister does not meet me.
 (C) I will not leave the place until the minister meet me.
 (D) I will not leave the place until the minister meets me.
- 5.34** If I were you, I _____ that laptop. It's much too expensive.
 [AG, CE-2, EY, MT, PI]
 (A) Won't buy (B) Shan't buy
 (C) Wouldn't buy (D) Would buy
- 5.35** Choose the most appropriate set of words from the options given below to complete the following sentence.
 _____ is a will, _____ is a way.
 [AG, CE-2, EY, MT, PI]
 (A) Wear, there, their
 (B) Were, their, there
 (C) Where, there, there
 (D) Where, their, their
- 5.36** The volume of a sphere of diameter 1 unit is _____ than the volume of a cube of side 1 unit.
 [BT, CH, GG, ME-2, MN, PH]
 (A) Least (B) Less
 (C) Lesser (D) Low
- 5.37** Choose the statement(s) where the underlined word is used correctly :
 (i) A prone is a dried plum.
 (ii) He was lying prone on the floor.
 (iii) People who eat a lot of fat are prone to heart disease.
 [BT, CH, GG, ME-2, MN, PH]
 (A) (i) and (ii) only
 (B) (iii) only
 (C) (i) and (ii) only
 (D) (ii) and (iii) only

2017 IIT Roorkee

- 5.38** I _____ made arrangements had I _____ informed earlier.
 [BT, CY, EC-1, EY, PI]
 (A) could have, been
 (B) would have, being
 (C) had, have
 (D) had been, been
- 5.39** It is _____ to read this year's textbook _____ the last year's.
 [AE, EC-2, MA, MT, PE, PH]
 (A) easier, than
 (B) most easy, than
 (C) easier, from
 (D) easiest, from
- 5.40** Research in the workplace reveals that people work for many reasons _____.
 [CS-1, EE-1]
 (A) money beside.
 (B) beside money.
 (C) money besides.
 (D) besides money.
- 5.41** After Rajendra Chola returned from his voyage to Indonesia, he _____ to visit the temple in Thanjavur. [CS-1, EE-1]
 (A) was wishing (B) is wishing
 (C) wished (D) had wished
- 5.42** Saturn is _____ to be seen on a clear night with the naked eye. [CS-2, EE-2]
 (A) Enough bright
 (B) Bright enough
 (C) As enough bright
 (D) Bright as enough
- 5.43** The event would have been successful if you _____ able to come.
 [CE-2, IN, XE, XL]
 (A) are
 (B) had been
 (C) have been
 (D) would have been

- 5.44 The bacteria in milk are destroyed when it _____ heated to 80°C.

[CE-1, CH, MN]

- (A) would be (B) will be
(C) is (D) was

- 5.45 The ways in which this game can be played _____ potentially infinite.

[AG, GG, ME-2]

- (A) is (B) is being
(C) are (D) are being

2018 IIT Guwahati

- 5.46 The dress _____ her so well that they all immediately _____ her for appearance. The words that best fill blanks in the above are

[AE, MA, ME-2, PI]

- (A) complemented, complemented
(B) complimented, complemented
(C) complimented, complimented
(D) complemented, complimented

2019 IIT Madras

- 5.47 They have come a long way in _____ trust among the users.

[CE-1]

- (A) Creating (B) Created
(C) Creation (D) Create

- 5.48 The CEO's decision to quit was as shocking to Board as it was to _____.

[CE-1]

- (A) Myself (B) I
(C) Me (D) My

- 5.49 Hima Das was _____ only Indian athlete to win _____ gold for India.

[CE-2]

- (A) the, a (B) an, a
(C) an, the (D) the, many

- 5.50 The strategies that the company _____ to sell its products _____ house-to-house marketing.

[EC]

- (A) use, includes

- (B) uses, including

- (C) uses, include

- (D) used, includes

- 5.51 The fishermen, _____ the flood victims owed their lives, were rewarded by the government.

[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]

- (A) whom (B) to which

- (C) to whom (D) that

- 5.52 Until Iran came along, India had never been _____ in kabaddi.

[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]

- (A) defeated (B) defeating

- (C) defeat (D) defeatist

- 5.53 _____ I permitted him to leave, I wouldn't have had any problem with him being absent _____ I?

[CY, ME-1, MN]

- (A) Had, would

- (B) Have, would

- (C) Had, wouldn't

- (D) Have, wouldn't

- 5.54 Are there enough seats here? There are _____ people here than I expected.

[ME-2, TF, XE, XL]

- (A) Least

- (B) Many

- (C) More

- (D) Most

- 5.55 Once the team of analysts identify the problem, we _____ in a better position to comment on the issue. Which one of the following choices CANNOT fill the given blank.

[ME-2, TF, XE, XL]

- (A) Might be

- (B) Are going to be

- (C) Were to be

- (D) Will be

2020 IIT Delhi

- 5.56 He was not only accused of theft _____ of conspiracy.

[AE, AG, EC, GG]

- (A) but also (B) but even
(C) rather (D) rather than

- 5.57 This book, including all its chapters, _____ interesting. The students as well as instructor _____ in agreement about it.

[EE, EY, TF]

- (A) is, was (B) is, are
(C) were, was (D) are, are

- 5.58 People were prohibited _____ their vehicles near the entrance of the main administrative building. [EE, EY, TF]

- (A) to park (B) to have parked
(C) from parking (D) parking

- 5.59 Jofra Archer, the England fast bowler is _____ than accurate

[IN, ME-1, MT, PE, PH]

- (A) More fast (B) More faster
(C) Less fast (D) Faster

- 5.60 While I agree _____ his proposal this time, I do not often agree _____ him.

[CY, ME-2, PI]

- (A) to, with (B) to, to
(C) with, with (D) with, to

- 5.61 Rescue teams deployed _____ disaster hit areas combat _____ a lot of difficulties to save the people.

[CE-2]

- (A) in, with (B) with, with
(C) to, to (D) with, at

- 5.62 Raman is confident of speaking English _____ six months as he has been practising regularly _____ the last three weeks. [CS]

- (A) during, for (B) within, for
(C) for, in (D) for, since

- 5.63 Rajiv Gandhi Khel Ratna Award was conferred _____ Mary Kom, a six-time world champion in boxing, recently in a ceremony _____ the Rashtrapati Bhawan (the President's official residence) in New Delhi.

[AR, BM, BT, CH, MA, MN, ST, XE, XL]

- (A) to, at (B) on, at
(C) On, in (D) With, at

2021 IIT Bombay

- 5.64 Consider the following sentences :

- (i) I woke up from sleep.
(ii) I woked up from sleep.
(iii) I was woken up from sleep.
(iv) I was wokened up from sleep.

Which of the above sentences are grammatically **CORRECT**?

[EC, ES, PE, PI, ST]

- (A) (i) and (ii) (B) (ii) and (iii)
(C) (i) and (iii) (D) (i) and (iv)

- 5.65 (i) Arun and Aparna are here.
(ii) Arun and Aparna is here.
(iii) Arun's families is here.
(iv) Arun's family is here.

Which of the above sentences are grammatically **CORRECT**?

[AE, AR, BM, CE-2, MN, PH]

- (A) (i) and (ii) (B) (i) and (iv)
(C) (ii) and (iv) (D) (iii) and (iv)

- 5.66 Consider the following statements:

[ME-1, XH]

- (i) After his surgery, Raja hardly could walk.
(ii) After his surgery, Raja could barely walk.
(iii) After his surgery, Raja barely could walk.
(iv) After his surgery, Raja could hardly walk.

Which of the above sentences are grammatically CORRECT ?

- (A) (i) and (iii) (B) (i) and (ii)
(C) (iii) and (iv) (D) (ii) and (iv)

5.67 Consider the following sentences :

- (i) The number of candidates who appear for the GATE examination is staggering.
(ii) A number of candidates from my class are appearing for the GATE examination.
(iii) The number of candidates who appear for the GATE examination are staggering.
(iv) A number of candidates from my class is appearing for the GATE examination.

Which of the above sentences are grammatically CORRECT? [ME-2, MT]

- (A) (ii) and (iv) (B) (i) and (ii)
(C) (ii) and (iii) (D) (i) and (iii)

5.68 Consider the following sentences:

- (i) Everybody in the class is prepared for the exam.
(ii) Babu invited Danish to his home because he enjoys playing chess.

Which of the following is the CORRECT observation about the above two sentences? [BT, CH, CS-1, MA, TF]

- (A) (i) is grammatically incorrect and (ii) is unambiguous
(B) (i) is grammatically correct and (ii) is unambiguous
(C) (i) is grammatically correct and (ii) is ambiguous
(D) (i) is grammatically incorrect and (ii) is ambiguous

2022 IIT Kharagpur

5.69 Mr. X speaks _____ Japanese _____ Chinese.

- (A) either/nor (B) also/but
(C) neither/nor (D) neither/or

[ECE]

5.70 After playing _____ hours of tennis, I am feeling _____ tired to walk back.

[ME-1]

- (A) too / too (B) too / two
(C) two / two (D) two / too

5.71 Writing too many things on the _____ while teaching could make the students get _____.

[ME-2]

- (A) bored / board (B) board / bored
(C) board / board (D) bored / bored

2023 IIT Kanpur

5.72 A duck named Donald Duck says “All ducks always lie.”

Based only on the information above, which one of the following statements can be logically inferred with *certainty*?

[CE-1]

- (A) Donald Duck always lies.
(B) Donald Duck always tells the truth.
(C) Donald Duck’s statement is true.
(D) Donald Duck’s statement is false.

2024 IISc Bangalore

5.73 In the given text, the blanks are numbered (i) – (iv). Select the best match for all the blanks.

Following a row (i) the shopkeeper (ii) the price of a frying pan, the cook stood (iii) a row to withdrawn cash (iv) the ATM booth.

- (A) (i) with (ii) over (iii) at (iv) with
(B) (i) at (ii) over (iii) over (iv) in
(C) (i) with (ii) over (iii) in (iv) at
(D) (i) over (ii) with (iii) over (iv) at

[EE]

- 5.74** In the given text, the blanks are numbered (i)-(iv). Select the best match for all the blanks.

Yoko Roi stands _____⁽ⁱ⁾ as an author for standing _____⁽ⁱⁱ⁾ as an honorary fellow, after she stood _____⁽ⁱⁱⁱ⁾ her writings that stand _____^(iv) the freedom of speech.

- (A) (i) out (ii) down (iii) in (iv) for
(B) (i) down (ii) out (iii) by (iv) in
(C) (i) down (ii) out (iii) for (iv) in
(D) (i) out (ii) down (iii) by (iv) for

[IN, CE-2]

- 5.75** In the given text, the blanks are numbered (i)–(iv). Select the best match for all the blanks.

Prof. P _____⁽ⁱ⁾ merely a man who narrated funny stories. _____⁽ⁱⁱ⁾ in his blackest moments he was capable of self-deprecating humor.

Prof. Q _____⁽ⁱⁱⁱ⁾ a man who hardly narrated funny stories. _____^(iv) in his blackest moments was he able to find humor.

- (A) (i) was (ii) Only (iii) wasn't (iv) Even
(B) (i) wasn't (ii) Even (iii) was (iv) Only
(C) (i) was (ii) Even (iii) wasn't (iv) Only
(D) (i) wasn't (ii) Only (iii) was (iv) Even

[ME]

- 5.76** In the given text, the blanks are numbered (i) – (iv). Select the best match for all the blanks.

Steve was advised to keep his head _____⁽ⁱ⁾ before heading _____⁽ⁱⁱ⁾ to bat; for, while he had a head _____⁽ⁱⁱⁱ⁾ batting, he could only do so with a cool head _____^(iv) his shoulders.

- (A) (i) down (ii) down (iii) on (iv) for

- (B) (i) on (ii) down (iii) for (iv) on
(C) (i) down (ii) out (iii) for (iv) on
(D) (i) on (ii) out (iii) on (iv) for

[CS-1]

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- 5.77** Even though I had planned to go skiing with my friends. I had to _____ at the last moment because of an injury. Select the most appropriate option to complete the above sentence.

[CE-2, XE]

- (A) back up (B) back of
(C) back on (D) back out

- 5.78** The President, along with the Council of Ministers, _____ to visit India next week.

Select the most appropriate option to complete the above sentence.

[CE-2, XE]

- (A) wish (B) wishes
(C) will wish (D) is wishing

- 5.79** Identify the grammatically correct sentence :

[ME, PE]

- (A) It is I who am responsible for this fiasco.
(B) It is myself who is responsible for this fiasco.
(C) It is I who is responsible for this fiasco.
(D) It is I who are responsible for this fiasco.

- 5.80** Ravi had _____ younger brother who taught at _____ university. He was widely regarded as _____ honorable man.

Select the option with the correct sequence of articles to fill in the blanks.

[CS-1]

- (A) a; a; an (B) the; an; a
(C) a; an; a (D) an; an; a

- 5.81 We _____ tennis in the lawn when it suddenly started to rain. Select the most appropriate option to complete the above sentence. [PI, DA]

(A) Have been playing
(B) Had been playing
(C) Would have been playing
(D) Could be playing

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- 5.82 'The shopkeeper sells lemons.' In this sentence, the word 'lemons' is the _____. [EE, PI, CE-1]

(A) object (B) subject
(C) predicate (D) verb

- 5.83 Suresh said, "I did it yesterday."

[IN, XE]

Which one of the following options is the correct form of this sentence in indirect speech?

(A) Suresh said that I did it yesterday.
(B) Suresh says I did it yesterday.
(C) Suresh says that he did it the day before.
(D) Suresh said that he had done it the day before.

Answers

Grammar

5.1	B	5.2	A	5.3	D	5.4	B	5.5	D
5.6	D	5.7	D	5.8	C	5.9	D	5.10	B
5.11	A	5.12	C	5.13	C	5.14	B	5.15	B
5.16	B	5.17	C	5.18	D	5.19	B	5.20	C
5.21	B	5.22	B	5.23	B	5.24	A	5.25	A
5.26	B	5.27	B	5.28	A	5.29	B	5.30	C
5.31	C	5.32	B	5.33	D	5.34	C	5.35	C
5.36	B	5.37	D	5.38	A	5.39	A	5.40	D
5.41	C	5.42	B	5.43	B	5.44	C	5.45	C
5.46	D	5.47	A	5.48	C	5.49	A	5.50	C
5.51	C	5.52	A	5.53	A	5.54	C	5.55	C
5.56	A	5.57	B	5.58	C	5.59	A	5.60	A
5.61	A	5.62	B	5.63	A	5.64	C	5.65	B
5.66	D	5.67	B	5.68	C	5.69	C	5.70	D
5.71	B	5.72	D	5.73	C	5.74	D	5.75	B
5.76	C	5.77	D	5.78	B	5.79	A	5.80	A
5.81	B	5.82	A	5.83	D				

Explanations

Grammar

5.1 (B)

The modal verb 'should' can be used in the context of recommendation, advisability, obligation (should be), or expectation (should be). So, it is inappropriate to use 'should be' in case of request. Also, the given sentence is not a case of obligation or expectation due to the reference of 'today'. Therefore the error is in 'should be given'.

Hence, the correct option is (B).

5.2 (A)

Concept of conditional sentences :

- (i) Zero conditional sentences : It is a structure which is used when we are talking about general truths or facts (things which always happen under certain conditions).

If the 'if clause' is in present simple tense then the 'main clause' will be in present simple tense as well.

- (ii) First conditional sentences : It is a structure in which we talk about the possibilities in the present or in the future. If the 'if clause' is in present simple tense then the 'main clause' will be in future simple tense.

- (iii) Second conditional sentences : It is a structure which is used when we talk about unrealistic situation in the present or in the future. If the 'if clause' is in past simple tense then the main clause includes should / would / could / might + verb(I).

- (iv) Third conditional sentence : It is a structure which is used when we talk about unrealistic situation in the past. If

the 'if clause' is in past perfect tense then the main clause includes would have / could have / should have / might have + verb(III).

In the given question, the 'if clause' is in past simple tense and comes under the category of second conditional sentences imaginary condition. Therefore the correct assertion is,

If the tired soldier wanted to lie down, he should take the mattress out on the balcony.

Hence, the correct option is (A).

5.3 (D)

"Two and two make four". The word "make" means "amount to". Two and two amount to (or make) four.

"Two and two are four" suggests that they are separate numbers.

Grammatically both options (C) and (D) are used in different sense. Hence, the general usage is two and two make four.

Hence, the correct option is (D).

5.4 (B)

In this sentence, preposition is used to make a relation between "Dare" and "Mistakes". So, correct sentence is "Dare to commit mistakes".

Hence, the correct option is (B).

5.5 (D)

The use of term 'very less' in option (D) is not appropriate because for amount of expenditure, the correct word would be 'much less' grammatically.

Hence, the correct option is (D).

5.6 (D)

Lay vs Lie

	Lay	Lie
Present tense	Lay	Lie
Past Tense	Laid	Lay
Past participle	Laid	Lain
Present Participle	Laying	Lying

Lay means to put somebody/something carefully in a particular position or on a surface. On the other hand lie whose past participle is lain is defined as "to be, to stay or to assume rest in a horizontal position".

Hence, the correct option is (D).

5.7 (D)

Here it is not clear about the specialist. It must be one of the specialist for that particular disease.

So, "to see a specialist" is correct. Rest all are fine in the statement.

"No sooner had" means the first part happened and the second part followed immediately. The first part uses past perfect tense and the second part uses simple past tense – which is actually required.

Hence, the correct option is (D).

5.8 (C)

Rule : According to concept of present simple tense if the object is 'He', 'she', 'name' or designation then 's' or 'es' is added at the end of the verb.

Now given sentence can be in present as well as past tense.

Correct form in Present tense :

- (i) Present simple tense :
The Headmaster wants to speak to you.
- (ii) Present continuous tense :
The Headmaster is wanting to speak to you.

Correct form in Past tense :

- (i) Past simple tense :
The Headmaster wanted to speak to you.
- (ii) Past continuous tense :
The Headmaster was wanting to speak to you.

Hence, the correct option is (C).

5.9 (D)

Given sentence states about subjects that students should learn. Mathematics is a subject in which students learn the method of computation. When mathematics is already mentioned it is inappropriate to add 'how to do computation'.

Hence, the correct option is (D).

5.10 (B)

In English grammar, we use 'to-infinitive' usually to express purpose or after certain verbs of thinking and feeling. In the given sentence, use of 'to-infinitive' is after the verb order which is neither essential nor required.

Hence, the correct option is (B).

5.11 (A)

Refer to the concept of Solution 5.2

The first clause in the given question is in past tense (unrealistic situation). So, second conditional sentence concept will be applied. Therefore the correct assertion is,

Were you a bird, you would fly in the sky.

Hence, the correct option is (A).

5.12 (C)

From option (C) : She is an European

Usage of article 'an' depends more on sound of the first alphabet of the word than on it being a vowel. If the sound is vowel, 'an' is used and if the sound is of consonant then 'a' is used.

In option (C), 'European' has a sound of 'yoo' which is a consonant. Therefore, appropriate article will be 'a' and not 'an'.

Hence, the correct option is (C).

5.13 (C)

The sentence is in past tense. So, the correct option is "was allowed to".

Hence, the correct option is (C).

5.14 (B)

'Each' and 'either' are incorrect because the pronoun used in the sentence is 'their'. Two words have been used in the sentence i.e. communication and interpersonal skills. So, 'both' is correct when we are referring to it.

Hence, the correct option is (B).

5.15 (B)

Advice is a noun which means an opinion or recommendation offered as a guide to action or conduct etc.

Advise is a verb which means to give counsel or offer opinion worth following.

Hence, the correct option is (B).

5.16 (B)

When a simple sentence is converted to question form and if the sentence is in past tense then in the question form, verb is changed to present tense with a 'did' added to the sentence.

Hence, the correct option is (B).

5.17 (C)

From option (A) :

knows (present tense),
will have (future tense)

From option (B) :

knew (past tense)
had (past tense)

From option (C) :

had known (Past perfect tense)
could have (perfect conditional)

From option (D) :

should have known (Present perfect tense)
would have (future tense)

In a type three conditional sentence, if the 'if clause' is in past perfect tense then the main clause will include should have / could have / would have + verb (III). Therefore in the given question, the correct assertion is,

If she had known how to calibrate the instrument, she could have done the experiment.

Hence, the correct option is (C).

5.18 (D)

To express a fact, present simple tense is used in general. Therefore, “experiences” is more appropriate.

Hence, the correct option is (D).

5.19 (B)

To find the correct answer, we simply ignore the additional information and focus on the first subject. In the given question, the first subject is ‘Dhoni’ because in the given sentence we have ‘as well as’ and not ‘and’. So the main subject is just Dhoni and therefore, ‘was’ is the appropriate word for the blank.

Hence, the correct option is (B).

5.20 (C)

Words in options (A) and (B) are nouns and (D) is an adjective.

Hence, the correct option is (C).

5.21 (B)

In the given question, the part which contains error is *Q*. the correct assertion should be, The student corrected all the errors that the instructor had marked on the answer book.

Hence, the correct option is (B).

5.22 (B)

Words in option (A), (C) and (D) are nouns. “Let us” is followed by a verb.

Hence, the correct option is (B).

5.23 (B)

According to the concept of third conditional sentences, if the ‘if clause’ is in past perfect tense then the main clause includes should have / would have / could have + verb (III).

Hence the correct assertion is,

If the athlete had wanted to come first in the race, he should have practiced several hours every day.

Hence, the correct option is (B).

5.24 (A)

‘Between’ is followed by pronoun in object form.

Hence, the correct option is (A).

5.25 (A)

Correct versions :

Option (B) : The report was useless to them because there **was** no needed information in it.

Option (C) : Since the report did not contain the needed information, it was not **really** useful to them.

Option (D) : Since the report lacked needed information, it would not **have** been useful to them.

Therefore only option (A) is correct with respect to grammar and usage.

Hence, the correct option is (A).

5.26 (B)

The official answered **respectfully** that the complaints of the citizen would be looked into.

Hence, the correct option is (B).

5.27 (B)

Insure : Protection against possible contingency.

Ensure : Making sure or making certain that something will occur.

The correct use of underlined word is done only in option (B).

Hence, the correct option is (B).

5.28 (A)

Before superlative article ‘the’ has to be used. The expression ‘one of’ should take plural noun and so options (C) and (D) can’t be the answer.

Hence, the correct option is (A).

5.29 (B)

'lose' is a verb.

Hence, the correct option is (B).

5.30 (C)

In degrees of comparison, Mr. X is taller than Mr. Y.

- Positive degree – tall
- Comparative degree – taller
- Superlative degree – tallest

Hence, the correct option is (C).

5.31 (C)

Based on the given sentences option (C) is the correct sentence which is in the comparative degree. Options (A) and (B) convey the wrong comparison and (D) has double comparative degrees so they are wrong.

Hence, the correct option is (C).

5.32 (B)

'Manageable' is the correct spelling.

Hence, the correct option is (B).

5.33 (D)

Word 'until' itself negates the upcoming sentence, hence 'does not' is not required. According to rules of present simple tense, verb 'meet' should have 's', since the object is noun.

Hence, the correct option is (D).

5.34 (C)

According to the concept of second conditional sentences, if the 'if clause' is in past tense then the main clause includes should / would / could + verb (I).

Hence the correct assertion is,

If I were you, I wouldn't buy that laptop. It's much too expensive.

Hence, the correct option is (C).

5.35 (C)

Given sentence is a well-known quotation which goes as, where there is a will, there is a way.

Hence, the correct option is (C).

5.36 (B)

Given sentence compares between the volume of sphere and cube.

The comparative degree of less is **less**.

Hence, the correct option is (B).

5.37 (D)

Prone : Likely to suffer.

Prone : Tilted, inclined, facing downward.

Sentence (ii) and (iii) are correctly using the word prone.

Hence, the correct option is (D).

5.38 (A)

According to the concept of third conditional sentences, if the 'if clause' is in past perfect tense then the main clause includes should have / would have / could have + verb (III).

Hence the correct assertion is,

I could have made arrangements had

I been informed earlier.

Hence, the correct option is (A).

5.39 (A)

In the given question, there is a comparison between last year's text book and this year's text book. In case of comparison, we use comparative degree (verb (II)) and 'than'

Hence, the correct assertion is,

It is easier to read this year's textbook than the last year's.

Hence, the correct option is (A).

5.40 (D)

'Besides' means in addition to or apart from. The statement says that 'people work for many reasons' which will continue with apart from money. So, the correct assertion is,

“Research in the workplace reveals that people work for many reasons **besides money**”.

Hence, the correct option is (D).

5.41 (C)

When the main clause is in the past tense or past perfect tense, the subordinate clause must be in the past or past perfect tense. So, the correct assertion is,

“After Rajendra Chola returned from his voyage to Indonesia, he **wished** to visit the temple in Thanjavur”.

Hence, the correct option is (C).

5.42 (B)

With adjectives and adverb, **enough** comes after adjectives and adverbs.

With nouns, **enough** comes before noun.

In the given question, enough is used with bright which is an adjective, so enough will come after the adjective.

So **bright enough** is the **correct option**.

Hence, the correct option is (B).

5.43 (B)

According to the concept of third conditional sentences, if the ‘if clause’ is in past perfect tense then the main clause includes should have / would have / could have + verb (III).

Hence the correct assertion is,

The event would have been successful if you had been able to come.

Hence, the correct option is (B).

5.44 (C)

In case of factual sentences, the dependent and independent bot clauses are in present simple tense.

The bacteria in milk are destroyed when it is heated to 80°C.

Hence, the correct option is (C).

5.45 (C)

The object in the given sentence is ‘the ways’ which is in plural form so, the most appropriate word is ‘are’.

The ways in which this game can be played **are** potentially infinite.

Hence, the correct option is (C).

5.46 (D)

Complemented : adding extra feature to something.

Complimented : Remark of admiration

The dress added extra feature to her looks i.e. complemented her looks. So, everyone complimented her on her appearance.

Hence, the correct option is (D).

5.47 (A)

The phrase “have come a long way” means progress. The given sentence is in present perfect continuous tense i.e. subject + has/have + verb(ing)

Therefore, in the given sentence, the correct flow will be, “They have come a long way in **creating** trust among the users”.

Hence, the correct option is (A).

5.48 (C)

‘I’, ‘me’ and ‘myself’ are subjective, objective and reflective pronouns respectively.

In the given sentence, CEO is subject and quitting is verb and object is missing from the sentence, which means we require an objective pronoun (i.e. ‘me’).

Hence, the correct option is (C).

5.49 (A)

Article ‘the’ is definite article. It limits the meaning of a noun to one particular thing. In the given sentence, it is specified that Hima Das was ‘the’ only Indian athlete to win. Article ‘a’ is used before words that start with consonants.

Therefore, the correct form of sentence will be, 'Hima Das was the only Indian athlete to win a gold for India'.

Hence, the correct option is (A).

5.50 (C)

'Company' is a singular noun, hence it will take verb with 's' i.e. 'uses' and strategies is plural so 'include' is correct.

Hence, the correct option is (C).

5.51 (C)

'Whom' is used to refer of the object of the verb or proposition. In the given sentence, fishermen is object and flood victims are subject. Here, we are talking about fishermen's accomplishments in the sentence, so to refer them we can use 'whom' or to whom.

Between 'whom' and 'to whom' latter one is more appropriate while referring.

Hence, the correct option is (C).

5.52 (A)

The given sentence is in past perfect tense. So verb will be in third form i.e. defeated.

Hence, the correct option is (A).

5.53 (A)

Given sentence is the third type of conditional clause. In which first clause is in past perfect tense and subsequent clause includes would have / should have / would not have / should not have.

Due to past perfect tense in first clause, 'Had' will be appropriate. In the subsequent clause, the question part should use 'would' because of use of 'would not have' in the sentence.

Hence, the correct option is (A).

5.54 (C)

The above sentence belongs to the criteria of comparison. So we directly go through the option which show comparative degree.

Hence, the correct option is (C).

5.55 (C)

The initial statement of the sentence 'once the analysts identify the problem' suggests that completion of first part will lead to the possibility of second part mentioned in the latter part of statement. It means that the blank will either be a word that describes possibility or future.

Only option (C) describes the past, which can not be used in the subject.

Hence, the correct option is (C).

5.56 (A)

"not only" and "but also" form a standard co-ordinating conjunctions.

Hence, the correct option is (A)

5.57 (B)

'Book' is a singular noun, so it will take singular verb 'is'

When 'as well as' is part of the sentence then the verb must agree with the noun before 'as well as'.

So "the students as well as" will take the verb 'are'.

Hence the correct option is (B).

5.58 (C)

The verb 'prohibit' means to forbid or prevent, it is followed by the preposition 'form'.

Hence, the correct option is (C).

5.59 (A)

The sentence refers to two adjectives, **more fast** than accurate, comparing one being more than the other.

Hence, the correct option is (A).

5.60 (A)

Agree to something is used to show consent to a request.

Agree with someone is used to shows same opinion.

5.61 (A)

Deployed **in** disaster hit areas

Combat **with** a lot of difficulties

∴ in, with are the right phrasal verb.

Hence, the correct option is (A).

5.62 (B)

Given statements implies a time frame, thus **within** six months would be grammatically correct. For the second blank, it indicates a time period of three week, therefore **for** would be appropriate to use.

Hence, the correct option is (B).

5.63 (A)**5.64 (C)**

- (i) I woke up from sleep. (correct)
- (ii) I woked up from sleep. (not appropriate)
- (iii) I was woken up from sleep. (correct)
- (iv) I was wokened up from sleep. (not appropriate)

As we know wake, woke, woken/waked are three forms of verb.

Hence, the correct option is (C).

5.65 (B)

Two subjects joined by 'and' becomes plural, hence plural verb is there in the first statement.

In the fourth sentence the subject is 'family' which is singular. Hence, in this case we use a singular verb.

Hence, the correct option is (B).

5.66 (D)

Grammatically correct statements are :

- (i) After his surgery, Raja could hardly walk.
- (ii) After his surgery, Raja could barely walk.

Hardly/barely have similar meanings i.e. negative and they are used after the verb.

Hence, the correct option is (D).

5.67 (B)

"The number of" is singular and it takes singular verb.

"A number of" is plural and it takes plural verb.

Hence, the correct option is (B).

5.68 (C)

It is an ambiguous statement because it has more than one possible meaning as who enjoys playing chess is not clear from the given sentence. It may be Babu or Dinesh.

Hence, the correct option is (C).

5.69 (C)

"either" is used with "or"

"neither" is used with "nor"

Because of these fixed combinations option (A) and option (D) are eliminated.

Option (B), in this option we are not getting contrast tone in given filler that's why this option is also eliminated.

Hence, the correct option is (C).

5.70 (D)

In first filler we need to mention number so option (A) and (B) are eliminated and in second filler we are getting the sense of exhausted, so it should be 'too'

Hence, the correct option is (D).

5.71 (B)

In first filler, we have 'the' (article) just before it so we need noun here. So option (A) and (D) are eliminated and in second filler we need verb.

Writing too many things on the board while teaching could make the students get bored.

Hence, the correct option is (B).

5.72 (D)

Given : A duck named Donald Duck says "All ducks always lie."

According to the given information Donald Duck's statement is false.

Hence, the correct option is (D).

5.73 (C)

The prepositions in option (C) accurately represent the relationships between the actions and locations in the context.

Hence, the correct option is (C).

5.74 (D)

The prepositions align appropriately with the intended meaning of the sentences.

Hence, the correct option is (D).

5.75 (B)

In the context, prof. p is described as not merely a man who narrated funny stories (i) and, in his blackest moments, capable of self-deprecating humor (ii). on the other hand, prof. Q is described as hardly a man who narrated funny stories (iii) and, in his blackest moments able to find humor.

Hence, the correct option is (B).

5.76 (C)

Steve was advised to keep his head (i) down before heading (ii) out to bat. While he had a head (iii) for batting, he could only do so with a cool head (iv) on his shoulders. The prepositions align appropriately with the intended meaning.

Hence, the correct option is (C).

5.77 (D)

From option (A) :

Back up : Means to support or move backward, which does not fit the context.

From option (B) :

Back of : Not a standard phrasal verb.

From option (C) :

Back on : Incorrect as it does not convey withdrawal from a plan.

From option (D) :

"Back out" means to withdraw from a commitment or agreement, which fits the context of cancelling skiing plans.

Thus, the correct answer is : (D) back out.

Hence, the correct option is (D).

5.78 (B)

The phrase "along with the Council of Ministers" is an additional phrase that does not affect the main subject (The President).

From option (B) :

Since "The President" is singular, the verb must also be singular : "wishes".

Thus, the correct answer is : (B) wishes.

From option (A) :

Wish - Incorrect, as it is plural, but the subject "The President" is singular.

From option (C) :

Will wish - Incorrect, as it changes the meaning to future intent rather than a current statement.

From option (D) :

is wishing - Incorrect, as "is wishing" is not the correct tense for this structure.

Hence, the correct option is (B).

5.79 (A)

From option (A) : "It is I who am responsible for this fiasco."

1. The phrase "It is I" is correct because after the verb "to be," the subject pronoun "I" should be used instead of "me."
2. "Who" refers to "I" and follows the verb "am," which is the correct first-person singular form.

This sentence is Correct

From option (B) : "It is myself who is responsible for this fiasco."

"Myself" is a reflexive pronoun and cannot be used as the subject of the sentence.

This sentence is incorrect

From option (C) : "It is I who is responsible for this fiasco."

"Who" refers to "I," so the verb should be "am" instead of "is."

This sentence is incorrect

From option (D) : "It is I who are responsible for this fiasco."

"Are" is incorrect because "who" refers to "I," which requires "am."

This sentence is incorrect.

Hence, the correct option is (A)

5.80 (A)

- a is used before younger brother because younger is a consonant sound.
- a is used before university because starts with "Ju" sound which is a consonant sound.
- an is used before honorable because honorable starts with a silent "h" making the next sound a vowel.

Hence, the correct option is (A).

5.81 (B)

Sentence :

"We ____ tennis in the lawn when it suddenly started to rain."

Understanding the Context :

The sentence describes an ongoing past action ("playing tennis") that was interrupted by another past event ("it suddenly started to rain"). This indicates that the correct tense should reflect a continuous action in the past before an interruption.

From option (A) :

Have been playing- Incorrect.

"Have been playing" is present perfect continuous, used for actions that started in the past and continue into the present. Since the event is entirely in the past, this is incorrect.

From option (B) :

Had been playing : Correct.

"Had been playing" is past perfect continuous, which is used for an action that was ongoing before another past event occurred. This perfectly fits the sentence structure.

From option (C) :

Would have been playing : Incorrect.

This is a conditional form, which would be used in hypothetical scenarios (e.g., "If it had not rained, we would have been playing"). Since no condition is mentioned, this is not the best choice.

From option (D) :

Could be playing : Incorrect.

This suggests possibility rather than an actual past action, so it does not fit the given sentence.

Hence, the correct option is (B).

5.82 (A)

Sentence:

The shopkeeper sells lemons.

Subject → The shopkeeper (the person performing the action)

Verb → sells (the action)

Object → lemons (the thing receiving the action)

Because "lemons" receives the action of selling, it is the object.

Hence, the correct option is (A).

5.83 (D)

Suresh said, "I did it yesterday."

While converting direct → indirect speech:

Reporting verb: said (past)

Simple past → past perfect

yesterday → the day before

Therefore,

Suresh said that he had done it the day before.

Hence, the correct option is (D).



6

Case Studies

INTRODUCTION :

Case studies usually comprise a short paragraph followed by question on conclusions; assumptions; inferences; and strengthening or weakening arguments, related to the given paragraph.

Other question types like “Fact, Inference and Judgment”, “Probably / Definitely True or False”, “Course of Action”, “Cause - Effect” and “Syllogisms” are also included under the category of critical reasoning.

To solve these question it is important to understand the context of the paragraph from which they are asked.

“Critical Reasoning’ implies arriving at a logical conclusion after a careful evaluation of all relevant data and assumptions.

Critical reasoning usually has a small passage followed by certain questions. This question type is used to evaluate your ability to think logically and draw inferences, derive conclusions or make judgments on the basis of given data.

Let us first take a look at the important terms involved in solving these type of questions :

1. Premise
2. Assumption
3. Inference
4. Conclusion

1. Premise :

“A premise is a statement that is assumed to be true and from which a conclusion can be drawn.”
A premise is the basis of an argument. There cannot be any argument without a premise on which it is based. However there can be more than one premise on which an argument is based.

The following argument is presented as an example :

“Unfit players hamper the progress of the entire team. That is the reason Viru should not be selected in the team.”

Here the premise is that “Unfit players hamper the progress of the entire team” and the subsequent argument is based on this premise.

2. Assumption :

“An assumption is a statement which can be either true or false, but is accepted as true only for the purpose of the argument which follows.”

An assumption is that which, although bearing no explicit mention, is taken for granted and on the basis of which a conclusion is drawn.

Using the same example as given above :

“Unfit players hamper the progress of the entire team. That is the reason Viru should not be selected in the team.”

It may be noted that in this case the assumption is that “Viru is unfit” even though it is not explicitly mentioned and without this assumption the argument falls apart.

3. Inference :

“A logical process of drawing conclusions from a collection of data and relationships between data and potential conclusions.”

An inference is logically derived on the basis of factual data, which along with the assumption, leads to the conclusion.

Using the same example as given above :

Unfit players hamper the progress of the entire team. That is the reason Viru should not be selected in the team.”

In this case, “Viru is going to hamper the entire team” is an inference based on the premise that unfit players hamper the team and on the assumption that Viru is unfit.

Other inferences can also be made like: “Viru was considered for the selection of the team” or “Viru wanted to be part of the team”. Such statements though not explicitly mentioned can also be logically derived.

4. Conclusion :

“A conclusion is a final proposition, after the consideration of evidence, assumption or premise.”

A conclusion is what the author of an argument arrives at following the premise, the data given, the assumptions made and the inference drawn.

Using the following argument :

“Unfit players hamper the progress of the entire team. That is the reason Viru should not be selected in the team.”

In this case, “Viru should not be selected in the team” is the conclusion.

To understand these concepts better let us take another example.

Consider the following argument :

“Recruitment managers dislike candidates who are not punctual and who arrive late for interviews. Hence, it is unlikely that Ram will be selected for the job today”.

In this case the premise is : “Recruitment managers dislike candidates who are not punctual and who arrive late for interviews”.

The assumption is : “Ram was late for the interview”.

The inference drawn is : “The recruitment manager will probably dislike Ram because he was late”.

The conclusion drawn is : “Ram will not be selected for the job”.

GENERAL NOTE ON CRITICAL REASONING :

To solve critical reasoning question, one should not only keep in mind the structure of any argument presented above but also keep in mind the most common flaws in reasoning.

1. Association-causation flaw :

The Association-Causation flow refers to thinking that an event is the cause of another, merely because it precedes the other event chronologically.

Question based on this principle try to lead you into erroneously thinking that an event or action led to another merely because of the sequence in which they appeared, thus giving rise to the Association-Causation flaw.

The sequence of events or chronology is not a criterion for determination when there is actually no cause effect relationship. In critical reasoning, the knowledge of this common flaw can be used to correctly assess an argument and by keeping this principle in mind “Cause-Effect” type questions can be solved quite easily.

Example :

Consider the statement :

“India got independence after the end of the second World War.”

If a conclusion is drawn from this statement- “India got independence because of the second World War.” then it is faulty because even though India independence chronologically follows the second World War, there is no cause-effect relationship in the given statement.

2. Composition flaw :

This refers to thinking that something that applies to one particular action, event or situation is also applicable to other actions, events or situations in general. Difficult reasoning questions usually encourage you to make this mistake. You should always carefully check a critical reasoning question to see whether the example presented can be considered representative of the general population; i.e. you should verify whether you can logically extrapolate from the given example to the general.

Example :

Consider the statement :

“Today’s Physics test was very difficult.”

If a conclusion is drawn from this statement that- “Physics is generally a difficult subject for most students” then it is fault because you cannot extrapolate the difficulty of physics as a subject in general on the basis of one test

3. Fallacy of analogy :

This refers to thinking that the line of reasoning used in one scenario applies to another scenario by assuming that all other parameter remain the same. You should be careful to compare the two scenarios to see whether there is a subtle change in the situation which makes the parallel reasoning inappropriate. The important thing in this case is to identify what exactly causes the difference between the two similar scenarios. In critical reasoning, it is also extremely important to avoid over-analyzing an argument.

Example :**Consider the statement :**

“Students who study for eight hours a day are successful in the examination. So sportsmen who want to win tournaments should practice for eight hours every day.”

This argument is faulty because the reasoning for success in studies cannot be applied directly to sports which can have many other considerations.

4. Red Herring :

This refers to being diverted from the actual argument by some topic which seems relevant but is actually not related to the argument at hand

Difficult questions in critical reasoning try to throw you off track by introducing concepts which trap you into thinking on the basis of what you already know rather than sticking to the information given.

Example :**Consider the statement :**

“People who do not want to pay Income Tax according to the law should not be forced because the Government has other sources of revenue which it can use to cover the deficit.”

This is faulty because the law should be enforced regardless of whether the Government can cover up the deficit caused by people breaking the law.

5. Argumentum ad populum :

This refers to the assumption that a particular argument is valid because many people think so. This reasoning is improper because the opinion of many people is not a criterion to determine the actual validity of any argument.

Example :**Consider the statement :**

“The claim made by environmental agencies about the adverse effects of global warming is not valid because most of the people in India say that they do not feel there is any difference in the climate and they are not affected by it.”

This argument is faulty because the opinion of the people cannot determine the validity of an argument which is based on scientific facts.

6. Non sequitur :

This refers to making an argument by stating a conclusion after presenting the premise even though the conclusion cannot be logically drawn, from the premise.

Example :**Consider the statements :**

“It is difficult for sportsmen, especially cricketers to play continuously for many months at a stretch. Therefore, we must build a sports academy which trains many more sportspeople”. This is faulty because the conclusion drawn does not follow from the stated premise.

7. Faulty appeal to authority

This refers to using the views of a person or organization specializing in one field to support an argument in another. This fallacy can be identified when authority which is referred to in an argument is not an expert in the subject being discussed in that argument.

Example :

Consider the statements :

“The famous actor Salman has invested a lot of money in the stock market. The stock market must be generating a very good return on investment”. This argument is faulty because the actor’s judgment in the field of stocks cannot be taken as a basis for saying that the stock market will generate good returns.

GENERAL QUESTION PATTERN :

Critical reasoning question are similar in nature to the reading comprehension questions. However, in this case, the passages given are usually shorter and all questions are inferential.

The types of question usually asked in this section are as follows:

1. Identifying the conclusion :

The conclusion that can be drawn on the basis of the inference in the given passage is selected.

Example 1 :

Companies selling expensive consumer durables like televisions or refrigerators increase their advertising expenditure during the festival season. They usually declare several promotional schemes or offer heavy discounts to attract buyers who traditionally shop for such expensive items on auspicious festival days. What can you conclude from the above passage?

1. People buy refrigerators and televisions on auspicious days in the festival season.
2. Advertising expenditure in the non-festival season is extremely low.
3. People expect consumer durable companies to offer heavy discounts during the festival season.
4. Consumer durable companies consider the festival season to be a very important period for increasing sales.
5. Advertising rates during the festival season are much higher as compared to other times of the year.

Explanation :

On reading the passage you can see that it describes the efforts taken by the consumer durable companies to attract buyers during the festival season.

Option 1 cannot be concluded because the passage just mentions that some buyers traditionally shop on auspicious days. This cannot be generalized to make it applicable to all people.

Option 2 cannot be concluded because there is no way of assessing the degree of spending during the non-festival period on the basis of the given information that some companies increase their advertising spends during the festival season.

Option 3 may be true but it cannot be concluded as there is no information regarding the view of people in general in relation to the strategy of the companies to offer discounts.

Option 4 is a reasonable conclusion that can be drawn on the basis of the given passage. If the companies are making the special efforts mentioned in the passage, then it can be concluded that they consider the festival season very important.

Option 5 cannot be concluded as there is no data to support it in the given passage.

Hence, the correct answer is option 4.

2. Identifying the assumption :

Choose the assumption mentioned in the given passage used by the author, to draw the conclusion.

Example 2 :

Engineering student who will complete their graduation this year will find it difficult to get used to the advanced technology being used in the corporate world. The university which designs the engineering course should concentrate on upgrading the infrastructure and improving the quality of teaching to meet industrial standards.

Which of the following assumptions does the above argument make?

1. There are more engineering students than job openings this year.
2. The engineering students graduating this year are not very determined or intelligent.
3. The infrastructure and teaching faculty currently available for engineering students is not up to corporate technological standards.
4. Engineering students will probably pursue management education instead of taking up jobs.
5. The university is not interested in the welfare of the students.

Explanation :

An assumption is something that has been taken for granted while making the argument in the above argument, the premise is that engineering students this year will find adjusting to the corporate world measures the university should take.

In this case, option 3 is the most probable assumption that the author may have made to arrive at the given conclusion since it is directly related to the action suggested by the author.

Options 1 and 4 are not relevant to the argument about the students not being able to adjust or the course of action for the university.

Options 2 may be true; however, if the author had made this assumption then the suggested course of action would not have been related to the university upgrading infrastructure and teaching. So option 2 cannot be the correct answer.

Hence, the correct answer is option 3.

Important :

Remember that the assumption ought to be assessed only with relevance to the argument given in the passage and not based on any additional knowledge or information on the subject.

3. Identifying A Strengthening Argument :

The statement which most strongly supports the argument in the given passage is chosen.

Example 3 :

IT companies are finding it difficult to retain employee with average attrition rates in the industry being as high as fifty percent per year. They should immediately double the salaries of all their employees to increase employee retention.

Which of the following, if true, most strengthens the argument?

1. Profits of IT companies have increased and they above argument?
2. A survey shows that most employees in the IT industry change jobs because of low salaries.
3. Employees care more about the work environment than salaries.
4. Salaries in the field of medicine are much higher than in IT.
5. Higher work pressure makes it necessary for most employees in IT to work overtime.

Explanation :

In the above passage, the author makes the argument that IT companies should double salaries of employees to reduce attrition which is very high.

Option 2 will most strengthen the argument because it says that the important reason for high attrition is low salaries. If this is the case, then the argument proposed by the author would be very relevant and strong.

Options 3, 4 and 5 are not relevant to the argument made. Hence they can be eliminated.

Option 1 is appropriate; however it does not strength the argument much. Just because the IT companies can afford a pay hike is not a valid reason to implement it since it does not say whether the pay hike will actually help.

Hence, the correct answer is option 2.

4. Identifying A Weakening Argument :

The statement which undermines or weakens the argument in the given passage is selected.

Example 4 :

To qualify for the Olympics, any team needs to be extremely fit. That is the reason why the India hockey team failed to qualify for the Olympics at Beijing.

Which of the following, if true most weakens the above argument?

1. The coach of the Indian hockey team was not skilled enough to train the team.
2. The Indian hockey team actually did not have the ambition to win an Olympic medal.
3. The Indian hockey team was certified to be completely fit by an independent medical consultant and a qualified physiotherapist.
4. The administrative body responsible for hockey is run in a completely unprofessional manner.
5. The India hockey team suffered from several bad decisions by the field umpires.

Explanation :

In the above argument, the premise is that any team needs to be extremely fit to qualify for the Olympics. The author has made an assumption that the Indian team was not fit and concluded that this is the reason for the Indian hockey team not qualify. Thus by negating the assumption, option 3 weakens the argument.

Options 1, 2, 3 and 5 offer alternative reasons why the Indian team did not qualify. However none of them weakens the argument made by the author.

Hence, the correct answer is option 3.

5. Parallel Reasoning :

A pattern of reasoning from the option given which is similar to the reasoning in the given passage is identified.

Example 5 :

Most Indian are not interested in learning Japanese, while some are interested in learning German.

Hence, Indian have more interest in the West rather than the East

Which of the following is analogous to the logic provided above?

1. Some Bengalis are not interested in Western Classical whereas most Bengalis are interested in folk music. Hence, Bengalis have more interest in the Classical music.
2. Some cricketers are not interested in learning baseball, while most cricketers are interested in learning football. Hence, cricketers have a liking for football.
3. Most hockey players are interested in Olympics while some of those are interested in Asian games. Hence Indian have more interest in Olympics.
4. Most tribal are not interested in classroom studies, while some are interested in learning from their elders. Hence, tribal have more interest in education from elders than the universally accepted mode of school education.
5. All the Indian in the US have made it big, some of them are returning to India. Hence, Indian from US find Indian more attractive than the US.

Explanation :

The main data draws conclusion on ALL Indians based on interest of SOME Indian and lack of interest of MOST Indians.

In option 1, the line of reasoning is the opposite of that in the main argument To be parallel, the logic should have been that Bengalis have more interest in folk music.

Option 2 does not draw comparison in the concluding statement between cricketers' interest in learning football over baseball.

In option 3, the premise talks about hockey players and the conclusion is on Indians. Therefore, option 3 is incorrect.

In option 5, the reasoning provided does not have the parallel reasoning provided in the main data.

The reasoning in option 4 is parallel to the main argument. Conclusion is drawn for ALL tribals based on what MOST are not interested in and what SOME are interested in. It is the same line of reasoning used in the main data.

Hence, the correct answer is option 4.

2010 IIT Guwahati

- 6.1** Modern warfare has changed from large scale clashes of armies to suppression of civilian populations. Chemical agents that do their work silently appear to be suited to such warfare; and regrettably, there exist people in military establishments who think that chemical agents are useful tools for their cause.

Which of the following statements best sums up the meaning of the above passage? **[All branches]**

- (A) Modern warfare has resulted in civil strife.
- (B) Chemical agents are useful in modern warfare.
- (C) Use of chemical agents in warfare would be undesirable.
- (D) People in military establishments like to use chemical agents in war.

- 6.2** **It has taken fifty six long and frustrating years to turn bronze into gold for India's Olympics aspirations. Beijing 2008 marks a defining moment in India's Olympic history. From Delhi to Beijing is a long journey but one that our Olympians have undertaken with courage.**

Which of the following statements best sums up the meaning of the above passage? **[TF]**

- (A) India's participation in Olympics has been frustrating.
- (B) Beijing Olympics was a landmark in India's Olympic history.
- (C) Our Olympians have undertaken a long journey to Beijing.
- (D) India's bronze medal turned into gold at Beijing.

- 6.3** **The ban on smoking in designated public places can save a large number of people from the well known effects of environmental tobacco smoke.**

Passive smoking seriously impairs respiratory health. The ban rightly seeks to protect non-smokers from its all effects.

Which of the following statements best sums up the meaning of the above passage: **[MN]**

- (A) Effects of environmental tobacco are well known.
- (B) The ban on smoking in public places protects the non smokers.
- (C) Passive smoking is bad for health.
- (D) The ban on smoking in public places excludes passive smoking.

2011 IIT Madras

- 6.4** In order to develop to full potential, a baby needs to be physically able to respond to the environment. **[GG, TF]**

It can be inferred from the passage that

- (A) Full physical potential is needed in order for a baby to be able to respond to the environment.
- (B) It is necessary for a baby to be able to physically respond to the environment for it to develop its full potential.
- (C) Response to the environment of physically able babies needs to be developed to its full potential.
- (D) A physically able baby needs to develop its full potential in order to respond to its environment.

- 6.5** **Nimbus clouds are dark and ragged, stratus clouds appear dull in colour and cover the entire sky. Cirrus clouds**

are thin and delicate, whereas cumulus clouds look like cotton balls.

[AE, MN]

It can be inferred from the passage that

- (A) A cumulus cloud on the ground is called fog
- (B) It is easy to predict the weather by studying clouds
- (C) Clouds are generally of very different shapes, sizes and mass
- (D) There are four basic cloud types: stratus, nimbus, cumulus and cirrus

- 6.6 **The horse has played a little known but very important role in the field of medicine. Horses were injected with toxins of diseases until their blood built up immunities. Then a serum was made from their blood. Serums to fight with diphtheria and tetanus were developed this way.**

It can be inferred from the passage, that horses were

[AG, CY, EC, EE,

IN, MA, MT, XE, XL]

- (A) Given immunity to diseases.
- (B) Generally quite immune to diseases.
- (C) Given medicines to fight toxins.
- (D) Given diphtheria and tetanus serums.

- 6.7 Few school curriculum include a unit on how to deal with bereavement and grief, and yet all students at some point in their lives suffer from losses through death and parting. Based on the above passage which topic would not be included in a unit on bereavement?

[AR, BT, CE, CH, CS, ME, PH, PI]

- (A) How to write a letter of condolence
- (B) What emotional stages are passed through in the healing process
- (C) What the leading causes of death are
- (D) How to give support to a grieving friend

2012 IIT Delhi

- 6.8 **One of the legacies of the Roman legions was discipline. In the legions, military law prevailed and discipline was brutal. Discipline on the battlefield kept units obedient, intact and fighting, even when the odds and conditions were against them.**

Which one of the following statements best sums up the meaning of the above passage?

[CY, EC, EE, IN, MA, MT, XE, XL]

- (A) Thorough regimentation was the main reason for the efficiency of the Roman legions even in adverse circumstances.
- (B) The legions were treated inhumanly as if the men were animals.
- (C) Discipline was the armies inheritance from their seniors.
- (D) The harsh discipline to which the legions were subjected to led to the odds and conditions being against them.

- 6.9 **Wanted temporary, part-time persons for the post of Field Interviewer to collect and collate economic data. Requirements High School-pass, must be available for Day, Evening and Saturday work. Transportation paid, expenses reimbursed.**

Which one of the following is the best inference from the above advertisement?

[BT, CE, CH, CS, ME, PH, PI]

- (A) Gender-discriminatory
- (B) Xenophobic
- (C) Not designed to make the post attractive
- (D) Non gender-discriminatory

- 6.10** The documents expose the cynicism of the government officials - and yet as the media website reflects, not a single newspaper has reported on their existence.

Which one of the following inferences may be drawn with the greatest accuracy from the above passage? [AR, GG, TF]

- (A) Nobody other than the government officials knew about the existence of the documents.
- (B) Newspapers did report about the documents but nobody cared.
- (C) Media reports did not show the existence of the documents.
- (D) The documents reveal the attitude of the government officials

- 6.11** In the early nineteenth century, theories of social evolution were inspired less by Biology than by the conviction of social scientists that there was a growing improvement in social institutions. Progress was taken for granted and social scientists attempted to discover its laws and phases.

Which one of the following inferences may be drawn with the greatest accuracy from the above passage?

Social scientists [AE, AG, MN]

- (A) did not question that progress was a fact.
- (B) did not approve of Biology.
- (C) framed the laws of progress.
- (D) emphasized Biology over Social Sciences.

2013 IIT Bombay

- 6.12** After several defeats in wars, Robert Bruce went in exile and wanted to

commit suicide. Just before committing suicide, he came across a spider attempting tirelessly to have its net. Time and again, the spider failed but that did not deter it to refrain from making attempts. Such attempts by the spider made Bruce curious. Thus, Bruce started observing the near impossible goal of the spider to have the net. Ultimately, the spider succeeded in having its net despite several failures. Such act of the spider encouraged Bruce not to commit suicide. And then, Bruce went back again and won many a battle, and the rest is history. Which of the following assertions is best supported by the above information?

[CS, ME, PI]

- (A) Failure is the pillar of success
- (B) Honesty is the best policy
- (C) Life begins and ends with adventures
- (D) No adversity justifies giving up hope

2014 IIT Kharagpur

- 6.13** The Palghat Gap (or Palakkad Gap), a region about 30 km wide in the southern part of the western Ghats in India, is lower than the hilly terrain to its north and south. The exact reasons for the formation of this gap are not clear. It results in the neighbouring regions of Tamil Nadu getting more rainfall from the south west monsoon and the neighbouring regions of Kerala having higher summer temperatures.

What can be inferred from this passage?

[CS-1, EE-1]

- (A) The Palghat gap is caused by high rainfall and high temperatures in southern Tamil Nadu and Kerala.
- (B) The regions in Tamil Nadu and Kerala that are near the Palghat Gap are low lying.

- (C) The low terrain of the Palghat Gap has a significant impact on weather patterns in neighbouring parts of Tamil Nadu and Kerala.
- (D) Higher summer temperatures result in higher rainfall near the Palghat Gap area.

6.14 Geneticists say that they are very close to confirming the generating roots of psychiatric illnesses such as depression and schizophrenia, and consequently, that doctors will be able to eradicate these diseases through early identification and gene therapy.

On which of the following assumptions does the statement above rely?

[CS-1, EE-1]

- (A) Strategies are now available for eliminating psychiatric illnesses.
- (B) Certain psychiatric illnesses have a genetic basis.
- (C) All human diseases can be traced back to genes and how they are expressed.
- (D) In the future, genetics will become the only relevant field for identifying psychiatric illnesses.
- 6.15** The old city of Koenigsberg, which had a German majority population before World War 2, is now called Kaliningrad. After the events of the war, Kaliningrad is now a Russian territory and has a predominantly Russian population. It is bordered by the Baltic sea on the north and the countries of Poland to the south and west and Lithuania to the east respectively. Which of the statements below can be inferred from this passage?

[CS-2, EE-2]

- (A) Kaliningrad was historically Russian in its ethnic make up.

- (B) Kaliningrad is a part of Russia despite it not being contiguous with the rest of Russia.

- (C) Koenigsberg was renamed Kaliningrad, as that was its original Russian name.

- (D) Poland and Lithuania are on the route from Kaliningrad to the rest of Russia.

6.16 The number of people diagnosed with dengue fever (contracted from the bite of a mosquito) in north India is twice the number diagnosed last year. Municipal authorities have concluded that measures to control the mosquito population have failed in this region.

Which one of the following statements, if true, does not contradict this conclusion?

[CS-2, EE-2]

- (A) A high proportion of the affected population has returned from neighbouring countries where dengue is prevalent.
- (B) More cases of dengue are now reported because of an increase in the municipal office's administrative efficiency.
- (C) Many more cases of dengue are being diagnosed this year since the introduction of a new and effective diagnostic test.
- (D) The number of people with malarial fever (also contracted from mosquito bites) has increased this year.
- 6.17** A dance programme is scheduled for 10:00 am, some students are participating in the programme and they need to come an hour earlier than the start of the event. These students should be accompanied

by a parent. Other students and parents should come in time for the programme. The instruction you think that is appropriate for this is [CS-3, EE-3]

(A) Students should come at 9:00 am and parents should come at 10:00 am.

(B) Participating students should come at 9:00 am accompanied by a parent, and other parents and students should come by 10:00 am.

(C) Students who are not participating should come by 10:00 am and they should not bring their parents. Participating students should come at 9:00 am.

(D) Participating students should come before 9:00 am parents who accompany them should come at 9:00 am. All others should come at 10:00.

6.18 By the beginning of the 20th century, several hypotheses were being proposed, suggesting a paradigm shift in our understanding of the universe. However, the clinching evidence was provided by experimental measurements of the position of a star which was directly behind our sun. [CS-3, EE-3]

Which of the following inference (s) may be drawn from the above passage?

(i) Our understanding of the universe changes based on the positions of stars.

(ii) Paradigm shifts usually occur at the beginning of centuries.

(iii) Stars are important objects in the universe.

(iv) Experimental evidence was important in confirming this paradigm shift.

(A) (i), (ii) and (iv) (B) (iii) only

(C) (i) and (iv) (D) (iv) only

6.19 Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis. From “BIG DATA” Viktor Mayer-Schonberger and Kenneth Cukier The main point of the paragraph is :

[AG, BT, CE-2, GG, IN, MN, PI, TF, XL]

(A) The twenty-first century is a digital world.

(B) Big data is obsessed with exactness.

(C) Exactitude is not critical in dealing with big data.

(D) Sparse data leads to a bias in the analysis.

6.20 Rajan was not happy that Sajan decided to do the project on his own. On observing his unhappiness, Sajan explained to Rajan that he preferred to work independently.

Which one of the statements below is logically valid and can be inferred from the above sentences? [AE, AR, CE-1, CH, CY, EY, MA, MT, PH, XE]

(A) Rajan has decided to work only in a group.

(B) Rajan and Sajan were formed into a group against their wishes.

(C) Sajan had decided to give in to Rajan's request to work with him.

(D) Rajan had believed that Sajan and he would be working together.

2015 IIT Kanpur

- 6.21 Read the following paragraph and choose the correct statement.

Climate change has reduced human security and threatened human well-being. An ignored reality of human progress is that human security largely depends upon environmental security. But on the contrary, human progress seems contradictory to environmental security. To keep up both at the required level is a challenge to be addressed by one and all. One of the ways to curb the climate change may be suitable scientific innovations, while the other may be the Gandhian perspective on small scale progress with focus on sustainability.

[AG, AR, BT, CH, CY, EC-1, EY, XE, XL]

- (A) Human progress and security are positively associated with environmental security.
- (B) Human progress is contradictory to environmental security.
- (C) Human security is contradictory to environmental security.
- (D) Human progress depends upon environmental security.
- 6.22 **Lamenting the gradual sidelining of the arts in school curricula, a group of prominent artists wrote to the Chief Minister last year, asking him to allocate more funds to support arts education in schools. However, no such increase has been announced in this year's Budget. The artists expressed their deep anguish at their request not being approved, but many of them remain optimistic about funding in the future.**

Which of the statement(s) below is/are logically valid and can be inferred from the above statements? [EC-2, ME-1]

- (i) The artists expected funding for the arts to increase this year.
- (ii) The Chief Minister was receptive to the idea of increasing funding for the arts.
- (iii) The Chief Minister is a prominent artists.
- (iv) Schools are giving less importance to arts education nowadays.
- (A) (iii) and (iv) (B) (i) and (iv)
- (C) (i), (ii) and (iv) (D) (i) and (iii)

- 6.23 Alexander turned his attention towards India, since he had conquered Persia.

Which one of the statements below is logically valid and can be inferred from the above sentence [CE-1, CS-3]

- (A) Alexander would not have turned his attention towards India had he not conquered Persia.
- (B) Alexander was not ready to rest on his laurels, and wanted to march to India.
- (C) Alexander was completely in control of his army and could command towards India.
- (D) Since Alexander's kingdom extended to Indian borders after the conquest of Persia, he was keen to move further.

- 6.24 Most experts feel that in spite of possessing all the technical skills required to be a batsman of the highest order, he is unlikely to be so due to lack of requisite temperament. He was guilty of throwing away his wicket several times after working hard to lay a strong

foundation. His critics pointed out that until he addresses to this problem, success at the highest level will continue to elude him.

Which of the statement (s) below is/are logically valid and can be inferred from the above passage? [CE-1, CS-3]

- (i) He was already a successful batsman at the highest level
 - (ii) He has to improve his temperament in order to become a great batsman
 - (iii) He failed to make many of his good starts count
 - (iv) Improving his technical skills will success
- (A) (iii) and (iv) (B) (ii) and (iii)
(C) (i), (ii) and (iii) (D) (ii) only

2016 IISc Bangalore

- 6.25 In a world filled with uncertainty, he was glad to have many good friends. He has always assisted them in times of need and was confident that they would reciprocate. However, the events of the last week proved him wrong. [EC-1, ME-1]

Which of the following inference(s) is/are logically valid and can be inferred from the above passage?

- (i) His friends were always asking him to help them.
 - (ii) He felt that when in need of help, his friends would let him down.
 - (iii) He was sure that his friends would help him when in need.
 - (iv) His friends did not help him last week.
- (A) (i) and (ii) (B) (iii) and (iv)
(C) (iii) only (D) (iv) only

- 6.26 Leela is older than her cousin Pavithra. Pavithra's brother Shiva is older than Leela. When Pavithra and Shiva are visiting Leela, all three like to play chess. Pavithra wins more often than Leela does.

Which one of the following statements must be **TRUE** based on the above?

[EC-1, ME-1]

- (A) When Shiva plays chess with Leela and Pavithra, he often loses.
- (B) Leela is the oldest of the three.
- (C) Shiva is a better chess player than Pavithra.
- (D) Pavithra is the youngest of the three.

- 6.27 Social science disciplines were in existence in an amorphous form until the colonial period when they were institutionalized. In varying degrees, they were intended to further the colonial interest. In the time of globalization and the economic rise of postcolonial countries like India, conventional ways of knowledge production have become obsolete.

Which of the following can be logically inferred from the above statements?

[EC-2, ME-3]

- (i) Social science disciplines have becomes obsolete.
 - (ii) Social science disciplines had a pre-colonial origin.
 - (iii) Social science disciplines always promote colonialism.
 - (iv) Social science must maintain disciplinary boundaries.
- (A) (ii) only
(B) (i) and (iii) only
(C) (ii) and (iv) only
(D) (iii) and (iv) only

- 6.28** The overwhelming number of people infected with rabies in India has been flagged by the World Health Organization as a source of concern. It is estimated that inoculating 70% of pets and stray dogs against rabies can lead to a significant reduction in the number of people infected with rabies.

Which of the following can be logically inferred from the above sentences?

[AR, CY, EC-3, IN, MA, PE]

- (A) The number of people in India infected with rabies is high.
- (B) The number of people in other parts of the world who are infected with rabies is low.
- (C) Rabies can be eradicated in India by vaccinating 70% of stray dogs.
- (D) Stray dogs are the main source of rabies worldwide.
- 6.29** Computers were invented for performing only high-end useful computations. However, it is no understatement that they have taken over our world today. The internet, for example, is ubiquitous. Many believe that the internet itself is an unintended consequence of the original invention. With the advent of mobile computing on our phones, a whole new dimension is now enabled. One is left wondering if all these developments are good or, more importantly, required.
- Which of the statement(s) below is/are logically valid and can be inferred from the above paragraph? [CS-2, EE-1]
- (i) The author believes that computers are not good for us.
- (ii) Mobile computers and the internet are both intended inventions.

- (A) (i) only
- (B) (ii) only
- (C) both (i) and (ii)
- (D) neither (i) nor (ii)

- 6.30** A poll of students appearing for masters in engineering indicated that 60% of the students believed that mechanical engineering is a profession unsuitable for women. A research study on women with masters or higher degrees in mechanical engineering found that 99% of such women were successful in their professions. [AE, EE-2, TF, XE, XL]
- Which of the following can be logically inferred from the above paragraph?

- (A) Many students have misconceptions regarding various engineering disciplines.
- (B) Men with advanced degrees in mechanical engineering believe women are well suited to be mechanical engineers.
- (C) Mechanical engineering is a profession well suited for women with masters or higher degrees in mechanical engineering.
- (D) The number of women pursuing higher degrees in mechanical engineering is small.

- 6.31** Sourya committee had proposed the establishment of Sourya Institute of Technology (SITs) in line with Indian Institutes of Technology (IITs) to cater to the technology and industrial needs of a developing country.

Which of the following can be logical inferred from the above sentence?

Based on the proposal,

[AE, EE-2, TF, XE, XL]

- (i) In the initial years, SIT students will get degrees from IIT.

- (ii) SITs will have a distinct national objective.
- (iii) SIT like institutions can only be established in consultation with IIT.
- (iv) SITs will serve technological needs of a developing country.
- (A) (iii) and (iv) only
- (B) (i) and (iv) only
- (C) (ii) and (iv) only
- (D) (ii) and (iii) only

6.32 Indian currency notes show the denomination indicated in at least seventeen languages. If this is not an indication of the nation's diversity, nothing else is.

Which of the following can be logically inferred from the above sentences?

[CE-1, CS-1]

- (A) India is a country of exactly seventeen languages.
- (B) Linguistic pluralism is the only indicator of a nation's diversity.
- (C) Indian currency notes have sufficient space for all the Indian languages.
- (D) Linguistic pluralism is strong evidence of India's diversity.

6.33 Today we consider, Ashoka as a great ruler because of the copious evidence he left behind in the form of stone carved edicts. Historians tend to correlate greatness of a king at his time with the availability of evidence today.

Which of the following can be logically inferred from the above sentences?

[AG, CE-2, EY, MT, PI]

- (A) Emperors who do not leave significant sculpted evidence are completely forgotten.

- (B) Ashoka produced stone-carved edicts to ensure that later historians will respect him.
- (C) Statues of kings are a reminder of their greatness.
- (D) A king's greatness, as we know him today, is interpreted by historians.

6.34 Fact : If it rains, then the field is wet.

Read the following statements :

- (i) It rains
- (ii) The field is not wet
- (iii) The field is wet
- (iv) It did not rain

Which one of the options given below is **NOT** logically possible based on the given fact?

[BT, CH, GG, ME-2, MN, PH]

- (A) If (iii), then (iv)
- (B) If (i), then (iii)
- (C) If (i), then (ii)
- (D) If (ii), then (iv)

6.35 A smart city integrates all modes of transport, uses clean energy and promotes sustainable use of resources. It also uses technology to ensure safety and security of the city, something which critics argue, will lead to a surveillance state.

Which of the following can be logically inferred from the above paragraph?

- (i) All smart cities encourage the formation of surveillance states.
- (ii) Surveillance is an integral part of a smart city.
- (iii) Sustainability and surveillance go hand in hand in a smart city.
- (iv) There is a perception that smart cities promote surveillance.

[BT, CH, GG, ME-2, MN, PH]

- (A) (i) and (iv) only
- (B) (ii) and (iii) only
- (C) (iv) only
- (D) (i) only

2017 IIT Roorkee

- 6.36** “If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages, for though I have spent a lifetime in the country. I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for the impartial recording of these matters”.

Here, the word ‘antagonistic’ is closest in meaning to [BT, CY, EC-1, EY, PI]

- (A) impartial (B) argumentative
(C) separated (D) hostile

- 6.37** “If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages for though I have spent a lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for the impartial recording of these matters.”

Which of the following statement best reflects the author’s opinion?

[AE, EC-2, MA, MT, PE, PH]

- (A) An intimate association does not allow for the necessary perspective.
(B) Matters are recorded with an impartial perspective.

(C) An intimate association offers an impartial perspective.

(D) Actors are typically associated with the impartial recording of matters.

- 6.38** “The hold of the nationalist imagination on our colonial past is such that anything inadequately or improperly nationalist is just not history”.

Which of the following statements best reflects the author’s opinion?

[CS-1, EE-1]

- (A) Nationalist are highly imaginative.
(B) History is viewed through the filter of nationalism.
(C) Our colonial past never happened.
(D) Nationalism has to be adequately and properly imagined.

- 6.39** “We lived in a culture that denied any merit to literary works, considering them important only when they were handmaidens to something seemingly more urgent—namely ideology. This was a country where all gestures, even the most private were interpreted in political terms”.

The author’s belief that ideology is not as important as literature is revealed by the word :

[CS-2, EE-2]

- (A) ‘Culture’ (B) ‘Seemingly’
(C) ‘Urgent’ (D) ‘Political’

- 6.40** Bhaichung was observing the pattern of people entering and leaving a car service centre. There was a single window where customers were being served. He saw that people inevitably came out of the centre in the order that they went in. However, the time they spent inside seemed to vary a lot some people came out in a matter of minutes while for others it took much longer.

[CE-2, IN, XE, XL]

From this, what can one conclude?

- (A) The centre operates on a first-come-first-served basis, but with variable service times, depending on specific customer needs.
- (B) Customers were served in an arbitrary order, since they took varying amounts of time for service completion in the centre.
- (C) Since some people came out within a few minutes of entering the centre, the system is likely to operate on a last-come-first-served basis.
- (D) Entering the centre early ensured that one would have shorter service times and most people attempted to do this.

6.41 A map shows the elevations of Darjeeling, Gangtok, Kalimpong, Pelling and Siliguri.

Kalimpong is at a lower elevation than Gangtok. Pelling is at a lower elevation than Gangtok.

Pelling is at a higher elevation than Siliguri. Darjeeling is at a higher elevation than Gangtok.

Which of the following statements can be inferred from the paragraph above?

[CE-2, IN, XE, XL]

- (i) Pelling is at a higher elevation than Kalimpong.
- (ii) Kalimpong is at a lower elevation than Darjeeling.
- (iii) Kalimpong is at a higher elevation than Siliguri.
- (iv) Siliguri is at a lower elevation than Gangtok.
- (A) Only (i)
- (B) Only (ii) and (iii)
- (C) Only (ii) and (iv)
- (D) Only (iii) and (iv)

6.42 The old concert hall was demolished because of fears that the foundation would be affected by the construction of the new metro line in the area. Modern technology for underground metro construction tried to mitigate the impact of pressurized air pockets created by the excavation of large amounts of soil. But even with these safeguards, it was feared that the soil below the concert.

From this, one can infer that,

[CE-1, CH, MN]

- (A) the foundations of old buildings create pressurized air pockets underground, which are difficult to handle during metro construction.
- (B) metro construction has to be done carefully considering its impact on the foundations of existing building.
- (C) old building in an area form an impossible hurdle to metro construction in that area.
- (D) pressurized air can be used to excavate large amounts of soil from underground areas.

6.43 Two very famous sportsmen Mark and Steve happened to be brothers, and played for country *K*. Mark teased James, an opponent from country *E*. "There is no way you are good enough to play for your country". James replied, "Maybe not, but at least I am the best player in my own family".

[AR, ME-1, TF]

Which one of the following can be inferred from this conversation?

- (A) Mark was known to play better than James
- (B) Steve was known to play better than Mark
- (C) James and Steve were good friends
- (D) James played better than Steve

- 6.44** “Here, throughout the early 1820s, Stuart continued to fight his losing battle to allow his sepoys to wear their caste-marks and their own choice of facial hair on parade, being again reprimanded by the commander-in-chief. His retort that ‘A stronger instance than this of European prejudice with relation to this country has never come under my observations’ had no effect on his superiors”.

According to this paragraph, which of the statements below is most accurate?

[AR, ME-1, TF]

- (A) Stuart’s commander-in-chief was moved by this demonstration of his prejudice.
- (B) The Europeans were accommodating of the sepoys’ desire to wear their caste-marks.
- (C) Stuart’s ‘losing battle’ refers to his inability to succeed in enabling sepoys to wear caste-marks.
- (D) The commander-in-chief was exempt from the European prejudice that dictated how the sepoys were to dress.
- 6.45** If you are looking for a history of India or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages: for though I have spent a lifetime in the county. I lived too near the seat of events and was too intimately associated with the actors to get the perspective needed for the impartial recording of these matters.

Which of the following is closest in meaning to **cleaving**? [AG, GG, ME-2]

- (A) Deteriorating (B) Arguing
(C) Departing (D) Splitting

- 6.46** All people in a certain island are either “Knights” or “Knaves” and each person knows every other person’s identity. Knights NEVER lie and Knaves ALWAYS lie

P say “Both of us are knights” *Q* say “None of us are Knaves

Which one of the following can be logically inferred from the above?

[AG, GG, ME-2]

- (A) Both *P* and *Q* are knights
(B) *P* is knight; *Q* is a knave
(C) Both *P* and *Q* are knaves
(D) The identities of *P*, *Q* cannot be determined

2018 IIT Guwahati

- 6.47** A coastal region with unparalleled beauty is home to many species of animals. It is dotted with coral reefs and unspoilt white sandy beaches. It has remained inaccessible to tourists due to poor connectivity and lack of accommodation. A company has spotted the opportunity and is planning to develop a luxury resort with helicopter service to the nearest major city airport. Environmentalists are upset that this would lead to the region becoming crowded and polluted like any other major beach resorts. [EC]

Which one of the following statements can be logically inferred from the information given in the above paragraph?

- (A) The culture and tradition of the local people will be influenced by the tourists.

- (B) The region will become crowded and polluted due to tourism.
- (C) The coral reefs are on the decline and could soon vanish.
- (D) Helicopter connectivity would lead to an increase in tourists coming to the region.
- 6.48** The Cricket Board has long recognized John's potential as a leader of the team. However, his on-field temper has always been a matter of concern for them since his junior days. While this aggression has filled stadium with die-hard fans, it has taken a toll on his own batting. Until recently, it appeared that he found it difficult to convert his aggression into big scores. Over the past three seasons though, that picture of John has been replaced by a cerebral, calculative and successful batsman-captain. After many years, it appears that the team has finally found a complete captain.
- Which of the following statements can be logically inferred from the above paragraph? [EC]
- (i) Even as a junior cricketer, John was considered a good captain.
- (ii) Finding a complete captain is a challenge.
- (iii) Fans and the Cricket Board have differing views on what they want in a captain
- (iv) Over the past three seasons John has accumulated big scores.
- (A) (i) (ii) and (iii) only
- (B) (iii) and (iv) only
- (C) (ii) and (iv) only
- (D) (i) (ii), (iii) and (iv)

2019 IIT Madras

- 6.49** “The increasing interest in tribal characters might be a mere coincidence, but timing is of interest. None of this, though, is to say that the tribal hero has arrived in Hindi cinema, or that the new crop of characters represent the acceptance of the tribal character in the industry. The films and characters are too few to be described as a pattern”.
- What does the word ‘arrived’ mean in the paragraph above? [CE-1]
- (A) Came to a conclusion
- (B) Reached a terminus
- (C) Went to a place
- (D) Attained a status
- 6.50** The new cotton technology, Bollgard-II, with herbicide tolerant traits has developed into a thriving business in India. However, the commercial use of this technology is not legal in India. Notwithstanding that, reports indicate that the herbicide tolerant cotton had been purchased by farmers at an average of Rs 200 more than the control price of ordinary cotton and planted in 15% of the cotton growing area in the 2017 Kharif season. [CE-1]
- Which one of the following statements can be inferred from the given passage?
- (A) Farmers want to access the new technology for experimental purposes.
- (B) Farmers want to access the new technology if India benefits from it.
- (C) Farmers want to access the new technology even if it is not legal.
- (D) Farmers want to access the new technology by paying high price.

- 6.51** “Popular Hindi fiction, despite - or perhaps because of - its wide reach, often does not appear in our cinema. As ideals that viewers are meant to look up to rather than identify with, Hindi film protagonists usually read books of aspirational value : textbooks, English books, or high value literature.”

Which one of the following CANNOT be inferred from the paragraph above?

[CE-2]

- (A) Protagonists in Hindi movies, being ideals for viewers, read only books of aspirational value.
- (B) People do not look up to writers of textbooks, English books or high value literature.
- (C) Though popular Hindi fiction has wide reach : it often does not appear in the movies.
- (D) Textbooks, English books or high literature have aspirational value, but not popular Hindi Fiction.

- 6.52** The Newspaper reports that over 500 hectares of tribal land spread across 28 tribal settlements in Mohinitampuram forest division have already been “alienated”. A top forest official said. “First the tribal are duped out of their land holdings. Second, the families thus rendered landless are often forced to encroach further into the forests.”

On the basis of the information available in the paragraph, _____ is / are responsible for duping the tribal. [CE-2]

- (A) The Newspaper
- (B) It cannot be inferred who
- (C) Forest officials
- (D) Landless families

- 6.53** “A recent High Court Judgement has sought to dispel the idea of begging as a disease – which leads to its stigmatization and criminalization – and to regard it as a symptom. The underlying disease is the failure of the state to protect citizens who fall through the social security net.”

Which one of the following statements can be inferred from the given passage?

[CH, CS]

- (A) Beggars are lazy people who beg because they are unwilling to work
- (B) Beggars are created because of the lack of social welfare schemes
- (C) Begging is an offence that has to be dealt with firmly
- (D) Begging has to be banned because it adversely affects the welfare of the state

- 6.54** “Indian history was written by British historians - extremely well documented and researched, but not always impartial. History has to serve its purpose. Everything was made subservient to the glory of Union Jack. Latter-day Indian scholars presented a contrary picture.”

From the text above, we can infer that :

Indian history written by British Historians _____. [EC]

- (A) was not well documented and researched and was sometimes biased.
- (B) was well documented and not researched but was always biased.
- (C) was not well documented and researched and was always biased.
- (D) was well documented and researched but was sometimes biased.

- 6.55** An award-winning study by a group of researchers suggests that men are as prone to buying on impulse as women but women feel more guilty about shopping. Which one of the following statements can be inferred from the given text?

[EE]

- (A) All men and women indulge in buying on impulse
 (B) Some men and women indulge in buying on impulse
 (C) Few men and women indulge in buying on impulse
 (D) Many men and women indulge in buying on impulse
- 6.56** Since the last one year, after a 125 basis point reduction in repo rate by the Reserve Bank of India, banking institutions have been making a demand to reduce interest rates on small saving schemes. Finally, the government announced yesterday a reduction in interest rates on small saving schemes to bring them on par with fixed deposit interest rates. Which one of the following statements can be inferred from the given passage?

[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]

- (A) Whenever the Reserve Bank of India reduces the repo rate, the interest rates on small saving schemes are also reduced
 (B) Interest rates on small saving schemes are always maintained on par with fixed deposit interest rates
 (C) The government sometimes takes into consideration the demands of banking institutions before reducing the interest rates on small saving schemes

- (D) A reduction in interest rates on small saving schemes follow only after a reduction in repo rate by the Reserve Bank of India

- 6.57** The nomenclature of Hindustani music has changed over the centuries. Since the medieval period *dhrupad* styles were identified as *baanis*. Terms like *gayaki* and *baaj* were used to refer to vocal and instrumental styles, respectively. With the institutionalization of music education the term *gharana* became acceptable. *Gharana* originally referred to hereditary musicians from a particular lineage, including disciples and grand disciples.

Which one of the following pairings is NOT correct?

[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]

- (A) *dhrupad*, *baani*
 (B) *gayaki*, vocal
 (C) *baaj*, institution
 (D) *gharana*, lineage

- 6.58** “I read somewhere that in ancient times the prestige of a kingdom depended upon the number of taxes that it was able to levy on its people. It was very much like the prestige of a head-hunter in his own community.”

Based on the paragraph above, the prestige of a head-hunter depended upon _____.

[AE, AG, AR, BT, EY, GG, IN, MA, MT, PE, PH, PI, ST]

- (A) the prestige of the kingdom
 (B) the prestige of the heads
 (C) the number of taxes he could levy
 (D) the number of heads he could gather

- 6.59** Under a certain legal system, prisoners are allowed to make one statement. If

their statement turns out to be true then they are hanged. If the statement turns out to be false then they are shot. One prisoner made a statement and the judge had no option but to set him free. Which one of the following could be that statement? [CY, ME-1, MN]

- (A) You committed the crime
- (B) I committed the crime
- (C) I will be shot
- (D) I didn't commit the crime

6.60 Congo was named by Europeans. Congo's dictator Mobuto later changed the name of the country and the river to Zaire with the objective of Africanising names of person and space. However the name Zaire was a Portuguese alteration of Nzadi O Nzere, a local African term meaning "River that swallows Rivers". Zaire was the Portuguese name for the Congo river in the 16th and 17th centuries. Which one of the following statements can be inferred from the paragraph above? [CY, ME-1, MN]

- (A) Mobuto was not entirely successful in Africanising the name of his country.
- (B) Mobuto's desire to Africanise names was prevented by the Portuguese.
- (C) As a dictator Mobuto ordered the Portuguese to alter the name of the river to Zaire.
- (D) The name Nzadi O Nzere was of Portuguese origin.

6.61 While teaching a creative writing class in India, I was surprised at receiving stories from the students that were all set in distant places : in the American West with cowboys and in Manhattan penthouses with clinking ice cubes. This was, till an eminent Caribbean writer gave the writers in the once-colonised countries the confidence to see the shabby lives around them as worthy of being "told".

The writer of this passage is surprised by the creative writing assignments of his students, because _____.

[ME-2, TF, XE, XL]

- (A) Some of the students had written stories set in foreign places.
- (B) None of the students had written stories set in India.
- (C) Some of the students had written about ice cubes and cowboys.
- (D) None of the students had written about ice tubes and cowboys.

6.62 X is an online media provider. By offering unlimited and exclusive online content at attractive prices for a loyalty membership, X is almost forcing its customers towards its loyalty membership. If its loyalty membership continues to grow at its current rate, within the next eight years more households will be watching X than cable television.

Which one of the following statements can be inferred from the above paragraph? [ME-2, TF, XE, XL]

- (A) The X is cancelling accounts of non-members.
- (B) Cable television operators don't subscribe to X's loyalty membership.
- (C) Non-members prefer to watch cable television.
- (D) Most households that subscribe to X's loyalty membership discontinue watching cable television.

2020

IIT Delhi

6.63 The Canadian constitution requires that equal importance be given to English and French. Last year, Air Canada lost a lawsuit and had to pay a six-figure fine to a French speaking couple after they filed

complaints about formal in - flight announcements in English lasting 15 seconds, as opposed to informal 5 second messages in French.

The French - speaking couple were upset at _____. [AE, AG, EC, GG]

(A) the English announcements being longer than French ones.

(B) equal importance being given to English and French.

(C) the English announcements being clearer than the French ones.

(D) the in-flight announcements being made in English.

- 6.64** Non-performing Assets (NPAs) of a bank in India is defined as an asset, which remains unpaid by a borrower for a certain period of time in terms of interest, principal, or both. Reserve Bank of India (RBI) has changed the definition of NPA thrice during 1993-2004, in terms of the holding period of loans. The holding period was reduced by one quarter each time. In 1993, the holding period was four quarters (360 days). Based on the above paragraph, the holding period of loans in 2004 after the third revision was _____ days. [EE, EY, TF]

(A) 90 (B) 180

(C) 45 (D) 135

2021 IIT Bombay

- 6.65** Computers are ubiquitous. They are used to improve efficiency in almost all fields from agriculture to space exploration. Artificial intelligence (AI) is currently a hot topic. AI enables computer to learn, given enough training data. For humans, sitting in front of a computer for long hours can lead health issues.

Which of the following can be deduced from the above passage?

[EC, ES, PE, PI, ST]

(i) Nowadays, computers are present in almost all places.

(ii) Computers cannot be used for solving problems in engineering.

(iii) For humans, there are positive and negative effects of using computers.

(iv) Artificial intelligence can be done without data.

(A) (i) and (iii) (B) (ii) and (iv)

(C) (i), (iii) and (iv) (D) (ii) and (iii)

- 6.66** The importance of sleep is often overlooked by students when they are preparing for exams. Research has consistently shown that sleep deprivation greatly reduces the ability to recall the material learnt. Hence, cutting down on sleep to study longer hours can be counterproductive.

Which one of the following statements is the **CORRECT** inference from the above passage? [AG, EE, EY, GG]

(A) To do well in an exam, adequate sleep must be part of the preparation.

(B) Sleeping well alone is enough to prepare for an exam. Studying has lesser benefit.

(C) Students are efficient and are not wrong in thinking that sleep is a waste of time.

(D) If a student is extremely well prepared for an exam, he needs little or no sleep.

- 6.67** Statement : Either P marries Q or X marries Y. Among the given options below, the logical negation of the above statement is [CE-1, CY, IN]

(A) Neither P marries Q nor X marries Y.

(B) P does not marry Q and X marries Y

- (C) P marries Q and X marries Y.
 (D) X does not marries Y and P marries Q.
- 6.68** Human have the ability to construct worlds entirely in their minds, which don't exist in the physical world. So far as we know, no other species possesses this ability. This skill is so important that we have different words to refer to its different flavors, such as imagination, invention and innovation. Based on the above passage, which one of the following is TRUE? [CE-1, CY, IN]
- (A) The terms imagination, invention and innovation refer to unrelated skills.
 (B) No species possess the ability to construct worlds in their minds.
 (C) Imagination, invention and innovation are un-related to the ability to construct mental worlds.
 (D) We don't know of any species other than humans who posses the ability to construct mental worlds.
- 6.69** The author said, "Musicians rehearse before their concerts. Actors rehearse there roles before the opening of a new play. On the other hand, I find it strange that many public speakers think they can just walk on the stage and start speaking. In my opinion, it is no less important for public speakers to rehearse their talks." Based on the above passage, which one the following is TRUE?
 [AE, AR, BM, CE-2, MN, PH]
- (A) The author is of the opinion that rehearsing is more important only for musicians than public speakers.
 (B) The author is of the opinion that rehearsing is less important for public speakers than for musicians and actors.

(C) The author is of the opinion that rehearsing is important for musicians, actors and public speakers.

(D) The author is of the opinion that rehearsing is more important for actors than musicians.

- 6.70** "The increased consumption of leafy vegetables in the recent months is a clear indication that the people in the state have begun to lead a healthy lifestyle"

[ME-1, XH]

Which of the following can be logically inferred from the information presented in the above statement?

- (A) Leading a healthy lifestyle is related to a diet with leafy vegetables.
 (B) The people in the state have increased awareness of health hazards causing by consumption of junk foods.
 (C) The people in the state did not consume leafy vegetables earlier.
 (D) Consumption of leafy vegetables may not be the only indicator of healthy lifestyle.

- 6.71** Oxpeckers and rhinos manifest a symbiotic relationship in the wild. The oxpeckers warn the rhinos about approaching poachers, thus possibly saving the lives of the rhinos. Oxpeckers also feed on the parasitic ticks found on rhinos.
 [ME-1, XH]

In the symbiotic relationship described above, the primary benefits for oxpeckers and rhinos respectively are,

- (A) Oxpeckers get a food source, rhinos may be saved from the poachers.
 (B) Oxpeckers get a food source, rhinos have no benefit.

- (C) Oxpeckers save their habitat from poachers while the rhinos have no benefit.
- (D) Oxpeckers save the lives of poachers, rhinos save their own lives.
- 6.72** The world is going through the worst pandemic in the past hundred years. The air travel industry is facing a crisis, as the resulting quarantine requirement for travelers led to weak demand. In relation to the first sentence above, what does the second sentence do? [ME-2, MT]
- (A) The two statements are unrelated.
- (B) States an effect of the first sentence.
- (C) Restates an idea from the first sentence.
- (D) Second sentence entirely contradicts the first sentence.
- 6.73** Some people suggest Anti-Obesity Measures (AOM) such as displaying calorie information in restaurant menus. Such measures sidestep addressing the core problems that cause obesity, poverty and income inequality. Which one of the following statements summarizes the passage? [BT, CH, CS-1, MA, TF]
- (A) AOM are addressing the core problems and are likely to succeed.
- (B) The proposed AOM addresses the core problems that cause obesity.
- (C) AOM are addressing the problem superficially.
- (D) If obesity reduces, poverty will naturally reduce, since obesity causes poverty.
- 6.74** Listening to music during exercise improves exercise performance and reduces discomfort. Scientists researched whether listening to music while studying can help students learn better

and the results were inconclusive. Students who needed external stimulation for studying fared worse while students who did not need any external stimulation benefited from music. [CS-2, XE, XL]

Which one of the following statements is the CORRECT inference of the above passage?

- (A) Listening to music has a clear positive effect on physical exercise. Music has a positive effect on learning only in some students.
- (B) Listening to music has a clear positive effect both on physical exercise and on learning.
- (C) Listening to music has a clear positive effect on learning in all students. Music has a positive effect only in some students who exercise.
- (D) Listening to music has no effect on learning and a positive effect on physical exercise.

2022

IIT Kharagpur

- 6.75** Some people believe that “what gets measured, improves”. Some other believe that “what gets measured, gets gamed”. One possible reason for the difference in the beliefs is the work culture in organization. In organizations with good work culture, metrics help improve outcomes. However the same metrics are counterproductive in organizations with poor work culture. Which one of the following is the correct logical inference based on the information in the above passage?

[CSE]

- (A) Metrics are useful in organization with poor work culture

- (B) Metrics are always counter-productive in organizations with good work culture
- (C) Metrics are never useful in organization with good work culture
- (D) Metrics are useful in organizations with good work culture

6.76 Altruism is the human concern for the wellbeing of others. Altruism has been shown to be motivated more by social bonding, familiarity and identification of belongingness to a group. The notion that altruism may be attributed to empathy or guilt has now been rejected.

Which one of the following is the CORRECT logical inference based on the information in the above passage?

[EE]

- (A) Humans engage in altruism due to guilt but not empathy.
- (B) Humans engage in altruism due to group identification but not empathy.
- (C) Human engage in altruism due to empathy but not guilt.
- (D) Human engage in altruism due to empathy but not familiarity.

6.77 Mosquitoes pose a threat to human health. Controlling mosquitoes using chemicals may have undesired consequences. In Florida, authorities have used genetically modified mosquitoes to control the overall mosquito population. It remains to be seen if this novel approach has unforeseen consequences.

Which one of the following is the correct logical inference based on the information in the above passage?

[ECE]

- (A) Using genetically modified mosquitoes is better than using chemicals to kill mosquitoes because they do not have any side effects.
- (B) Using chemicals to kill mosquitoes may have undesired consequences but it is not clear if using genetically modified mosquitoes has any negative consequence.
- (C) Using chemicals to kill mosquitoes is better than using genetically modified mosquitoes because genetic engineering is dangerous.
- (D) Both using genetically modified mosquitoes and chemicals have undesired consequences and can be dangerous.

6.78 Rice, a versatile and inexpensive source of carbohydrate, is a critical component of diet worldwide. Climate change, causing extreme weather, poses a threat to sustained availability of rice. Scientists are working on developing Green Super Rice (GSR), which is resilient under extreme weather conditions yet gives higher yields sustainably.

Which one of the following is the CORRECT logical inference based on the information given in the above passage?

[IN, CH, PI]

- (A) GSR is an alternative to regular rice, but it grows only in an extreme weather.
- (B) Regular rice will continue to provide good yields even in extreme weather.
- (C) GSR may be used in future in response to adverse effects of climate change

(D) GSR grows in an extreme weather, but the quantity of production is lesser than regular rice

6.79 You should _____ when to say _____.
[CE-1]

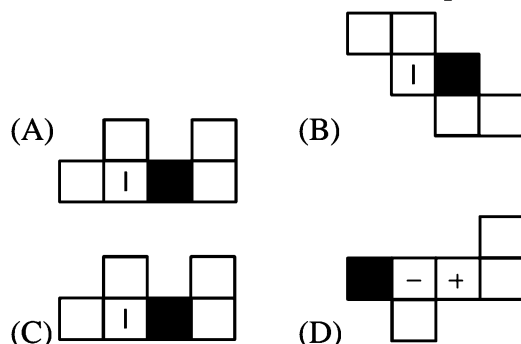
- (A) know/no (B) no/no
(C) know/know (D) no/know

6.80 Consider a cube made by folding a single sheet of paper of appropriate shape. The interior faces of the cube are all blank, the exterior faces that are not visible in the above view may not be blank.



Which one of the following represents a possible unfolding of the cube?

[CE-1]



6.81 In the last few years, several new shopping malls were opened in the city. The total number of visitors in malls is impressive. However the total revenue generated through sales in the shops in these malls is generally low.

Which one of the following is the correct logical inference based on the information in the above passage?

[CE-2]

- (A) Fewer people are visiting the malls but spending more.
(B) Fewer people are visiting the malls and not spending enough.

(C) More people are visiting the malls and spending more.

(D) More people are visiting the malls but not spending enough.

6.82 Humans are naturally compassionate and honest. In a study using strategically placed wallets that appear “lost”, it was found that wallets with money are more likely to be returned than wallets without money. Similarly, wallets that had a key and money are more likely to be returned than wallets with the same amount of money alone. This suggests that the primary reason for this behavior is compassion and empathy.

Which one of the following is the CORRECT logical inference based on the information in the above passage?

[ME-1]

- (A) Wallets with a key are more likely to be returned because people do not care about money
(B) Wallets with a key are more likely to be returned because people relate to suffering of others
(C) Wallets used in experiments are more likely to be returned than wallets that are really lost
(D) Money is always more important than keys

6.83 Fish belonging to species S in the deep sea have skins that are extremely black (ultra-black skin). This helps them not only to avoid predators but also sneakily attack their prey. However, having this extra layer of black pigment results in lower collagen on their skin, making their skin more fragile.

[ME-2]

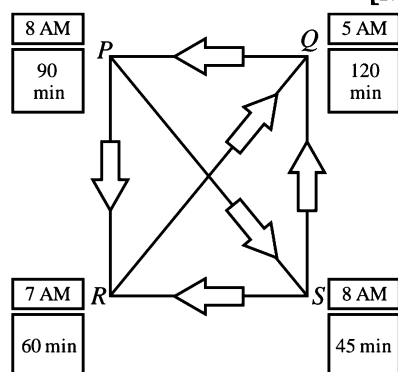
Which one of the following is the CORRECT logical inference based on the information in the above passage?

- (A) Having ultra-black skin is only advantageous to species S
- (B) Species S with lower collagen in their skin are at an advantage because it helps them avoid predators
- (C) Having ultra-black skin has both advantages and disadvantages to species S
- (D) Having ultra-black skin is only disadvantageous to species S but advantageous only to their predators

6.84 Four cities P, Q, R and S are connected through one-way routes as shown in the figure. The travel time between any two connected cities is one hour. The boxes beside each city name describe the starting time of first train of the day and their frequency of operation. For example, from city P, the first trains of the day start at 8 AM with a frequency of 90 minutes to each of R and S. A person does not spend additional time at any city other than the waiting time for the next connecting train.

If the person starts from R at 7 AM and is required to visit S and return to R, what is the minimum time required?

[ME-2]



- (A) 6 hours 30 minutes
- (B) 3 hours 45 minutes
- (C) 4 hours 30 minutes
- (D) 5 hours 15 minutes

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6.85 Identify the option that has the most appropriate sequence such that a coherent paragraph is formed : [ECE]

- P. Over time, such adaptations lead to significant evolutionary changes with the potential to shape the development of new species.
- Q. In natural world, organisms constantly adapt to their environments in response to challenges and opportunities.
- R. This process of adaptation is driven by the principle of natural selection, where favorable traits increase an organism's chances of survival and reproduction.
- S. As environments change, organisms that can adapt their behavior, structure and physiology to such changes are more likely to survive.

- (A) $P \rightarrow Q \rightarrow R \rightarrow S$
- (B) $Q \rightarrow S \rightarrow R \rightarrow P$
- (C) $R \rightarrow S \rightarrow Q \rightarrow P$
- (D) $S \rightarrow P \rightarrow R \rightarrow Q$

6.86 Identify the option that has the most appropriate sequence such that a coherent paragraph is formed :

- P. It is because deer, like most of the animals that tigers normally prey on, run much faster! It simply means, another day of empty stomach for the big cats.
- Q. Tigers spend most of their life searching for food.
- R. If they trace the scent of deer, tigers follow the trail, chase the deer for a mile or two in the dark, and yet may not catch them.

S. For several nights, they relentlessly prowl through the forest, hunting for a trail that may lead to their prey.

[EE]

(A) $S \rightarrow P \rightarrow R \rightarrow Q$

(B) $R \rightarrow P \rightarrow S \rightarrow Q$

(C) $Q \rightarrow S \rightarrow R \rightarrow P$

(D) $P \rightarrow Q \rightarrow S \rightarrow R$

6.87 Based only on the conversation below, identify the logically correct inference :

"Even if I had known that you were in the hospital, I would not have gone there to see you", Ramya told Josephine.

[IN, CS-2]

(A) Ramya knew that Josephine was in the hospital.

(B) Ramya did not know that Josephine was in the hospital.

(C) Ramya and Josephine were once close friends; but now, they are not.

(D) Josephine was in the hospital due to an injury to her leg.

6.88 "Why do they pull down and do away with crooked streets, I wonder, which are my delight, and hurt no man living? Every day the wealthier nations are pulling down one or another in their capitals and their great towns: they do not know why they do it; neither do I. It ought to be enough, surely, to drive the great broad ways which commerce needs and which are the life-channels of a modern city, without destroying all history and all the humanity in between: the islands of the past."

(From Hilaire Belloc's "The Crooked Streets")

Based only on the information provided in the above passage, which one of the following statements is true?

[CE-1, CH]

(A) The author of the passage takes delight in wondering.

(B) The wealthier nations are pulling down the crooked streets in their capitals.

(C) In the past, crooked streets were only built on islands.

(D) Great broad ways are needed to protect commerce and history.

6.89 "His life was divided between the books, his friends, and long walks. A solitary man, he worked at all hours without much method, and probably courted his fatal illness in this way. To his own name there is not much to show; but such was his liberality that he was continually helping others, and fruits of his erudition are widely scattered, and have gone to increase many a comparative stranger's reputation."

(From E.V. Lucas's "A Funeral")

Based only on the information provided in the above passage, which one of the following statements is true?

[CE-2, XE]

(A) The solitary man described in the passage is dead.

(B) Strangers helped create a grand reputation for the solitary man described in the passage.

(C) The solitary man described in the passage found joy in scattering fruits.

(D) The solitary man worked in a court where he fell ill.

6.90 Identify the option that has the most appropriate sequence such that a coherent paragraph is formed : [ME, PE]

- P. At once, without thinking much, people rushed towards the city in hordes with the sole aim of grabbing as much gold as they could.
- Q. However, little did they realize about the impending hardships they would have to face on their way to the city: miles of mud, unfriendly forests, hungry beasts and inimical local lords-all of which would reduce their chances of getting gold to almost zero.
- R. All of them thought that easily they could lay their hands on gold and become wealthy overnight.
- S. About a hundred years ago, the news that gold had been discovered in Kolar spread like wildfire and the whole State was in raptures.

- (A) $P \rightarrow Q \rightarrow R \rightarrow S$
- (B) $Q \rightarrow S \rightarrow R \rightarrow P$
- (C) $S \rightarrow Q \rightarrow P \rightarrow R$
- (D) $S \rightarrow P \rightarrow R \rightarrow Q$

6.91 "I put the brown paper in my pocket along with the chalks, and possibly other things. I suppose every one must have reflected how primeval and how poetical are the things that one carries in one's pocket: the pocket-knife, for instance the type of all human tools, the infant of the sword. Once I planned to write a book of poems entirely about the things in my pocket. But I found it would be too long: and the age of the great epics is past."
(From G.K. Chesterton's "A Piece of Chalk")

Based only on the information provided in the above passage, which one of the following statements is true? [CS-1]

- (A) The author of the passage carries a mirror in his pocket to reflect upon things.
- (B) The author of the passage had decided to write a poem 011 epics.
- (C) The pocket-knife is described as the infant of the sword.
- (D) Epics are described as too inconvenient to write.

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6.92 'When the teacher is in the room, all students stand silently.' [CS-1]

If the above statement is true, which one of the following statements is not necessarily true?

- (A) If any student is not standing silently, then the teacher is not in the room.
- (B) When the teacher is in the room, all students are silent.
- (C) If all students are standing, then the teacher is in the room.
- (D) When the teacher is in the room, all students are standing.

6.93 Combinatorics deals with problems involving counting. For example. "How many distinct arrangements of N distinct objects in M spaces on a circle are possible?" is a typical problem in combinatorics. This kind of counting is sometimes used in the modeling of several physical phenomena. Often, in such models, the different combinatorial possibilities are assigned probability values. Assigning probabilities enables the computation of the average values of physical quantities.

Consider the following statements
[CS-1]

P : Combinatorics is always invoked in the modeling of physical phenomena.

Q : Modeling some physical phenomena involves assigning probabilities to combinatorial possibilities in order to compute average values of physical quantities.

Based on the passage above, what can be inferred about statements P and Q?

- (A) P is False and Q is False
- (B) P is False and Q is True
- (C) P is True and Q is False
- (D) P is True and Q is True

6.94 'If his latest movie had been a commercial success, the actor would have made enough money to sponsor his next movie.'

Based only on the above sentence, which one of the following statements is true? [DA]

- (A) The actor will certainly sponsor his next movie.
- (B) His latest movie was a commercial success.
- (C) The actor made enough money from his latest movie.
- (D) His latest movie was not commercially successful.

Engineering Services Examination (ESE)

1. Consider the following students in an examination :

- A scored more than B
- C scored as much as D
- E scored less than F
- B scored more than C
- F scored less than D

Who scored the lowest?

- (A) E
- (B) C
- (C) D
- (D) F

[ESE 2020]

2. Of the five boys A, B, C and E two are good, one is poor and two are average in studies. Two of them study in post graduate classes and three in under graduate classes. One comes from a rich family, two from middle class families and two from poor families. One of them is interested in music, two in acting and one in sports. Of those studying in under graduate classes, two are average and one is poor in studies. Of the two boys interested in acting, one is a post graduate student. The one who is interested in music comes from a middle class families, are average in studies and one of them is interested in acting. The boy interested in sports comes from a poor family, while the one interested in music is industrious. E is industrious, good in studies comes from a poor family and is not interested in acting, music or sports. C is poor in studies in spite of being industrious. A comes from a rich family, is not industrious but good in studies. B is industrious and comes from a middle class family. Name the boy who is not industrious and is average in studies.

- (A) A
- (B) B
- (C) C
- (D) D

[ESE 2023]

3. At an electric Data Processing Unit five out of the eight program sets, P, Q, R, S, T, U V and W are to be operated daily. On any one day except for the first day of the month only here of the program sets must be the ones that were operated on

the previous day. The program operating must also satisfy the following conditions:

1. If program P is to be operated on a day, V cannot be operated on that day.
2. If Q is to be operated on a day, T must be one of the programs to be operated after Q.
3. If R is to be operated on a day, V must be one of the programs to be operated after R.
4. The last program to be operated on any day must be either S or U.

If the program sets R and W are to be operated on the first day which of the following could be the other programs on that day?

- (A) Q, V, S (B) Q, T, V
(C) T, S, U (D) T, S, V

[ESE 2023]

4. Read the following information carefully and answer the question given below it:

1. Eight doctors P, Q, R, S, T, U, V and W visit a charitable dispensary every day except on a holiday i.e., Monday.
2. Each doctor visits for one hour from Tuesday to Sunday except Saturday. The timings are 9 A.M. to 1 P.M. and 2 P.M. to 6 P.M., 1 P.M. to 2 P.M. is lunch break.
3. On Saturday it is opened only in the morning i.e., 9 A.M. to 1 P.M. and each doctor visits for only half an hour.
4. No other doctor visits the dispensary before doctor Q and after U.
5. Doctor W comes immediately after the lunch break and is followed by R.
6. S comes in the same order as P in the afternoon session.

If the lunch break and subsequent visiting hours are reduced by 15 minutes, at what time doctor U is expected to attend the dispensary?

- (A) 3.15 P.M. (B) 4 P.M.
(C) 4.15 P.M. (D) 4.45 P.M.

[ESE 2023]

5. Study the following information carefully and answer the question given below it:

1. P, Q, R, S, T and U are six members in a family in which there are two married couples.
2. T, a teacher, is married to the doctor who is mother of R and U.
3. Q, the lawyer, is married to P.
4. P has one son and one grandson.
5. Of the two married ladies one is housewife.
6. There is one student and one male engineer in the family

How is R related to U?

- (A) Brother only (B) Sister only
(C) Brother or Sister (D) Mother

[ESE 2023]

6. Read the following information carefully and answer the question that follow:

1. Madhu and Shobha are good in Dramatics and Computer Science.
2. Anjali and Madhu are good in Computer Science and Physics.
3. Anjali, Poonam and Nisha are good in Physics and History.
4. Nisha and Anjali are good in physics and mathematics.
5. Poonam and Shobha are good in History and Dramatics.

Who is good in History, Physics, Computer Science and Mathematics?

(A) Poonam

(B) Nisha

(C) Madhu

(D) Anjali

[ESE 2023]

7. Study the given information carefully and answer the question:

There are seven books, one each of Psychology, Hindi, English, Sociology, Economics, Education and Accountancy lying on a table one above the other. Sociology is on the top of all books. Accountancy is immediately below Education which is immediate below Sociology. Economics is immediately above Psychology but not in the middle. Hindi is immediately below Psychology. Which three books are between Accountancy and Hindi?

- (A) English, Economics and Psychology
 (B) Economics, Psychology and Education
 (C) Economics, Psychology and Hindi
 (D) Cannot be determined

[ESE 2024]

8. Read the information given below and answer the question:

There is a group of five girls. Hasini is second in height but younger than Madhavi. Pooja is taller than Pranati but younger in age. Madhavi and Pranati are of the same age but Madhavi is tallest

among them. Neelam is taller than Pooja and elder to Madhavi.

If they are arranged in the descending order of their ages who will be in fourth position?

- (A) Neelam
 (B) Hasini
 (C) Pranati
 (D) Data inadequate

[ESE 2024]

Answers		Case Studies							
6.1	D	6.2	D	6.3	B	6.4	B	6.5	D
6.6	B	6.7	C	6.8	A	6.9	D	6.10	D
6.11	A	6.12	D	6.13	C	6.14	B	6.15	B
6.16	D	6.17	B	6.18	D	6.19	C	6.20	D
6.21	B	6.22	B	6.23	A	6.24	B	6.25	B
6.26	D	6.27	A	6.28	A	6.29	D	6.30	C
6.31	C	6.32	D	6.33	D	6.34	C	6.35	D
6.36	D	6.37	A	6.38	B	6.39	B	6.40	A
6.41	C	6.42	B	6.43	B	6.44	C	6.45	D
6.46	D	6.47	D	6.48	C	6.49	D	6.50	C
6.51	A	6.52	B	6.53	B	6.54	D	6.55	B
6.56	C	6.57	C	6.58	D	6.59	C	6.60	A
6.61	B	6.62	D	6.63	A	6.64	A	6.65	A
6.66	A	6.67	A	6.68	D	6.69	C	6.70	A
6.71	A	6.72	B	6.73	C	6.74	A	6.75	D
6.76	B	6.77	B	6.78	C	6.79	A	6.80	MTA
6.81	D	6.82	B	6.83	C	6.84	A	6.85	B
6.86	C	6.87	B	6.88	B	6.89	A	6.90	D
6.91	C	6.92	C	6.93	B	6.94	D		
Engineering Services Examination (ESE)									
1.	A	2.	D	3.	D	4.	B	5.	C
6.	D	7.	A	8.	D				

Explanations

Case Studies

6.1 (D)

- (A) **Modern warfare has resulted in civil strife** : There is no direct consequence of warfare given, so it is not appropriate.
- (B) **Chemical agents are useful in modern warfare** : Passage does not say whether chemical agents are useful or not, so it is not appropriate.
- (C) **Use of chemical agents in warfare would be undesirable** : Given that people in military think these are useful, so undesirable is wrong.
- (D) **People in military establishment like to use chemical agents in war** : It is the

correct choice as last statement tells that military people think that chemical agents are useful tools for their cause (works silently in warfare).

Hence, the correct option is (D).

6.2 (D)

While we are talking about the sum up the meaning of passage.

The best suitable option is (D), as it states the core of the passage that India won the gold in Beijing Olympics for the first time.

Hence, the correct option is (D).

6.3 (B)

While we are directed to sum up the passage the best possible answer is option (B). “The Ban on smoking in public places protects the non smokers”.

Hence, the correct option is (B).

6.4 (B)

Option (B), can be inferred from the passage as the same meaning is given in the passage.

Hence, the correct option is (B).

6.5 (D)

Option (D) is correct as it logically follows the passage which talks about 4 cloud types.

Hence, the correct option is (D).

6.6 (B)

The author in the paragraph states that horses built up immunities when they are injected with toxins of diseases i.e. horses are generally immune to diseases.

Hence, the correct option is (B).

6.7 (C)

Bereavement : The process of mourning the loss, specially death of a loved one.

To learn how to deal with the loss or death (in the period of mourning), the unit on bereavement should involve how to ease the pain of loss, how to deal with funeral, letter of condolence, how to help your friends who are going through grief.

According to given options, option (C) is the only topic that does not help a student in any way to deal with grief.

Hence, the correct option is (C).

6.8 (A)

Here, there are three key words “legacy”, “legions” and “Discipline”. Even though the paragraph starts with “legacy” but the basic idea revolves around “Strict Discipline”, the author

has mentioned that the main reason because of which the legion is “obedient, intact and fighting” is “Discipline”. In option (A), we can see that “Strict Discipline” has been featured as “Regimentation.”

Hence, the correct option is (A).

Key Point

Legion = *noun*

1. A division of the Roman army, usually comprising 3000 to 6000 soldiers.
2. A military or semi-military unit.

Regimentation = *noun*

1. The act of regimenting or the state of being regimented.
2. The strict discipline and enforced uniformity characteristic of military groups.

6.9 (D)

Option (A) : Gender discriminatory

Since, there is no discrimination about gender mentioned in the argument, option (A) is incorrect.

Option (B) : Xenophobic

Xenophobic means condition of having fear of people from other countries. It is nowhere near related to the passage. So, option (B) is also incorrect.

Option (C) : Not designed to make the post attractive.

The advertisement clearly states that basic requirement is high school pass and transportation will be paid as well as expenses reimbursed which makes the profile lucrative (attractive)

So, option (C) is incorrect.

Option (D) : Non gender-discriminatory

The advertisement is clearly non-gender-discriminatory

Hence, the correct option is (D).

6.10 (D)

If we go with option elimination the correct answer will be option (D) as other options can be eliminated.

Option (A) is unrelated to the passage, they didn't explain about existence of documents, who knows and who don't knows.

Option (B) is totally wrong, as mentioned in the passage not a single newspaper has reported on their existence.

Option (C) cannot be the correct inference as it shows media published the report but did not show the existence of the documents while in the passage it is written that it is not reported yet.

Option (D) is clearly related to the passage as mentioned in the first line.

Hence, the correct option is (D).

6.11 (A)

By option elimination the best suitable answer is option (A),

Option (A) "Progress was taken for granted" is mentioned in the passage that's why "did not question that progress was a TRUE fact."

Option (B) is FALSE, as "were inspired less by Biology" mentioned in the passage does not mean Biology does not approved.

Option (C) is FALSE, "attempted to discover its laws" shows only attempted, success is not mentioned.

Option (D) is FALSE, it was the other way around.

Hence, the correct option is (A).

6.12 (D)

According to the given passage, it is clear that option (B) and (C) are wrong because there is no context about honesty or adventure.

Between option (A) and (D), option (D) is more suitable because the passage explains how Bruce

was motivated by the fact that despite having a near-impossible goal, the spider never gave up and continued its attempt to create its net without giving up hope.

Hence, the correct option is (D).

6.13 (C)

Option (A) can not be inferred from the passage because the palghat gap is causing the high rainfall and high temperatures, not the other way around. Option (B) and (D) are nowhere nearly mentioned in the passage.

Therefore, it can be inferred from the passage that the low terrain of the palghat gap has a significant impact on weather patterns in neighbouring parts of Tamil Nadu and Kerala.

Hence, the correct option is (C).

6.14 (B)

As it has been indicated that doctors will be able to eradicate psychiatric diseases such as depression and schizophrenia through gene therapy. So, it can be inferred that these psychiatric diseases have a genetic basis.

Hence, the correct option is (B).

6.15 (B)

The author states in the passage that after World War-II Kaliningrad became Russian territory but it is not contiguous with Russia because it used to have a German majority population.

Hence, the correct option is (B).

6.16 (D)

Municipal authorities admitted that it has been unable to control the mosquito population which is why the number of people with malarial fever has increased this year.

Hence, the correct option is (D).

6.17 (B)

The passage states that students participating in the programme, should come with a parent one hour earlier (9 am) and other students and parents should come in time for the programme (10 am) which clearly directs to option (B).

Hence, the correct option is (B).

6.18 (D)

The experimental measurements of the position of a star directly behind our sun gives proof for the hypothesis.

Hence, the correct option is (D).

6.19 (C)

It is stated in the passage that in the information-deprived analog era, there was a obsession with exactness because data was sparse and every data point was critical but in the era of big data, the thinking about merits of exactitude has to be changed which means big data is not obsessed with exactness or exactitude is not critical in dealing with big data.

Hence, the correct option is (C).

6.20 (D)

According to given passage, Rajan was not happy that Sajan decided to do the project on his own, which means that Rajan had thought that they will be doing the project together as mentioned in option (D).

Hence, the correct option is (D).

6.21 (B)

In the given passage, it is clearly stated that 'but on the contrary, human progress seems contradictory to environmental security'.

Hence, the correct option is (B).

6.22 (B)

In the given passage, it is stated that the artists wrote to chief minister last year asking him to

allocate more funds and when no such increase was announced, they expressed their and anguish which means they were expecting funding for the arts to increase this year so statement (i) can be logically inferred.

There is no mention of mind set of chief minister about whether he was receptive to the idea of increasing funding for the arts. Hence statement (ii) is incorrect.

Statement (iii) is nowhere near mentioned in the passage.

Lamenting the gradual sidelining of the arts in school curricula means the artists expressed sorrow about the ignorance of arts in school curriculum. So it can be inferred that schools are giving less importance to arts education nowadays.

Hence, the correct option is (B).

6.23 (A)

Given statement has no information about Alexander's army or Indian borders. Hence, option (C) and (D) are incorrect.

Option (B) states that Alexander was not ready to rest on his laurels. Laurel means a type of ancient crown which is an indication of victory. The given statement does not comment on the state of mind of Alexander i.e. whether he wanted to conquer different countries or not.

Therefore option (B) is in correct.

Hence, the correct option is (A).

6.24 (B)

Option (A) clearly contradicts the essence of the passage. Hence, it is incorrect.

Passage states that due to lack of requisite temperament, it is highly unlikely that he will become a batsman of higher order. So, he has to improve his temperament to become a great batsman.

The passage states that after laying a strong foundation i.e. after a good head start, he throws away his wicket i.e. He failed to make many of his good starts count.

Therefore, option (B) can be inferred from the passage.

Hence, the correct option is (B).

6.25 (B)

The words “was confident that they would reciprocate” and “last week proved him wrong” lead to statements (iii) and (iv) as logically valid inferences.

Hence, the correct option is (B).

6.26 (D)

From the given data, following relations are possible.

$L > P$ (Leela is older than Pavithra)

$S > L$ (Shiva is older than Leela)

So, Pavithra is youngest.

Hence, the correct option is (D).

6.27 (A)

Obsolete : No longer in use

Amorphous : Without any clear form

“Until the colonial period” means pre-colonial origin.

Hence, the correct option is (A).

6.28 (A)

It is stated in the passage that the number of people infected with rabies is overwhelming (very high) in India.

There is no information about infection of rabies in other parts of the world. Hence, option (B) is incorrect.

Given passage implies that by vaccinating 70% of stray dogs, number of people infected with rabies can be reduced but cannot be removed completely. Hence, option (C) is also incorrect.

[Eradicate : Destroy completely]

There is nothing related to option (D) is indicated or implied in the passage.

Hence, the correct option is (A).

6.29 (D)

Ubiquitous : Very common or existing everywhere.

The author wonders if all these developments are good or required (the author is not sure) therefore statement (i) can not be inferred.

Statement (i) in the question is nowhere nearly mentioned in the passage.

It is clearly said in the passage that internet is an unintended consequence which makes statement (ii) wrong.

Hence, the correct option is (D).

6.30 (C)

A poll says that women with masters or higher degrees in mechanical engineering are successful in their professions. This statement leads to the option (C), which is the best inference drawn.

Hence, the correct option is (C).

6.31 (C)

In the passage it is said that SIT will cater to the technology and industrial needs of a developing country. Statement (i) and (iii) state phrases like ‘in the initial years’ and ‘SIT like institutions can only be established in consultation with IIT’ which cannot be logically inferred, so (ii) and (iv) are the best inferences.

Hence, the correct option is (C).

6.32 (D)

The word ‘at least’ gives away the fact that there are more than 17 languages. So, option (A) is incorrect.

Option (C) is nowhere related to the passage.

The last statement of the passage shows that linguistic pluralism is a strong evidence of India’s diversity.

Hence, the correct option is (D).

6.33 (D)

The given passage states that the reason because of which **we consider** Ashoka as a great ruler is that he left behind evidence in form of stone carved edicts which were found by historians.

Therefore, a king's greatness, as we know him today, is interpreted by historians.

Hence, the correct option is (D).

6.34 (C)

Fact : If it rains, then the field is wet correct statements are :

(logically correct)

- (i) If it rains then field is wet
- (ii) If the field is not wet then it did not rain
- (iii) If the field is wet then It did not rain.
(possibility)

Option (C) is logically negating the given fact.

Hence, the correct option is (C).

6.35 (D)

Given passage states that critics have perception that smart cities promote surveillance.

Therefore, only statement (iv) can be logically inferred.

Hence, the correct option is (C).

6.36 (D)

Antagonistic : An opponent or enemy.

Impartial : Not favouring one more than another.

Argumentative : Tending to argue.

Separated : Divide into parts.

Hostile : Showing dislike or opposition.

Hence, the correct option is (D).

6.37 (A)

As given passage states "I lived too near the seat of events, and was too intimately associated with

the actors, to get the perspective needed for the impartial recording of these matters", it means that due to the fact that he was too intimate with the actors and the events, he did not have an impartial perspective.

Hence, the correct option is (A).

6.38 (B)

The author said in the passage that everything related to colonial past has a hold of nationalist imagination. Nationalism that is improperly represented is not history i.e. History is viewed through the filter of nationalism.

This statement best reflects the author's opinion based on the given paragraph.

Hence, the correct option is (B).

6.39 (B)

Seemingly means external appearance as disguised from true character.

'Considering them important only when they were handmaidens (means helping) to something seemingly more urgent' but in reality it is not so urgent.

So, ideology is not as important as literature is revealed by the word "seemingly" only.

Hence, the correct option is (B).

6.40 (A)

The passage states that the people come out of the center in the order that they came in. So, the center operates on a first-come-first-served basis and the time that the people stayed inside the center varies according to whatever kind of service they required.

Hence, the correct option is (A).

6.41 (B)

Given : A map shows the elevations of Darjeeling, Gangtok, Kalimpong, Pelling and Siliguri.

According to question,

- (i) Darjeeling is at the highest elevation.
- (ii) Kalimpong and Pelling are at lower elevation than Gangtok.
- (iii) Siliguri is at a lower elevation than Pelling.

From point (ii), statement-II can be inferred.

Siliguri is at a lower elevation than Pelling and Pelling is at a lower elevation than Gangtok. Therefore, statement-IV can be inferred from the paragraph.

Hence, the correct option is (B).

6.42 (B)

The passage states that pressurized air pockets are created underground due to the excavation of large amount of soil. So, options (A) and (D) are incorrect. The passage indicates that due to the construction of metro line, foundation of the old concert hall are effected, not the other way around. So, option (C) is also incorrect.

Hence, the correct option is (B).

6.43 (B)

According to the given passage, James states that he may not be good enough to play for his country but at least he is the best player in his own family which indicates that in Mark's family he wasn't the best player (making Steve a better player than Mark).

Hence, the correct option is (B).

6.44 (C)

Reprimanded : Disapproval of something strongly.

From option (A) :

According to the passage, the commander-in-chief strongly disapproved of Stuart's fight.

So, option (A) is incorrect.

From option (B) :

Passage states that Stuart was fighting a battle with his superiors to let the sepoys' wear their

caste-marks i.e. Europeans were not accommodating

So, option (B) is incorrect.

From option (C) :

Passage states that Stuart was losing his battle to allow his sepoys' to wear their caste marks which means he was unable to succeed in battle of providing his sepoys' the right of wearing their caste marks.

So, option (C) is correct.

From option (D) :

There is no mention of commander-in-chief's exemption of European prejudice.

So, option (D) is incorrect.

Hence, the correct option is (C).

6.45 (D)

Cleaving : Splitting or sever.

The given passage talks about the division of historical India into India and Pakistan after British Raj was over.

Hence, the correct option is (D).

6.46 (D)

Given :

- (i) All people in a certain island are either 'knights' or 'knaves'
 - (ii) *P* says 'both of us are knights'.
Q says 'none of us are knaves'.
 - (iii) Knights never lie and knaves always lie.
- If *P* is a knight then both *P* and *Q* are knights because knights never lie and if *Q* is also a knight then he is also telling the truth that none of them are knaves.

Hence, both are knights.

If *P* is a knave and lying then both *P* and *Q* are knaves and *Q* is also lying that none of them are knaves.

Hence, both are knaves.

Therefore, their identities can not be logically inferred from above data.

Hence, the correct option is (D).

6.47 (D)

From option (A) :

The culture and tradition of the local people will be influenced by the tourists.

The given statement is nowhere near mentioned or indicated in above passages. Hence, option (A) is incorrect.

From option (B) :

The region will become crowded and polluted due to tourism.

The company is planning to develop resort near major city airport (not around coastal region). So the region cannot become crowded and polluted. Hence, it cannot be logically inferred.

From option (C) :

The coral reefs are on the decline and could soon vanish.

There is no mention of coral reef being on the verge of declining or getting vanished. Hence, option (C) is incorrect.

From option (D) :

Helicopter connectivity would lead to an increase in tourists coming to the region.

The fact that a company is planning to develop the resort with helicopter service to the nearest major city airport is due to the reason that people from various places can visit the resort which would lead to increased tourism.

Hence, the correct option is (D).

6.48 (C)

- (i) **Even as a junior cricketer, John was considered a good captain :** In the passage, it is stated that John's on field temper has always been a concern since his junior days which means he was not considered a good captain as a junior cricketer.

Hence, statement (i) is incorrect.

- (ii) **Finding a good captain is challenging :**

It is stated in the passage that 'After many years, it appears that the team has finally found a complete captain' which means that team did not have a complete captain before which indicates that finding a good captain is challenging.

Hence, statement (ii) can be logically inferred.

- (iii) **Fans and the cricket board have different views of captain :** There is no mention of the views of the fans regarding qualities of a captain.

Hence, statement (iii) is incorrect.

- (iv) **Over the past three seasons, John is scoring big scores :** It is stated in the passage that 'Over the past three seasons though, that picture of John has been replaced by a cerebral, calculative and successful batsman-captain' which means John has been accumulating big scores in the previous three seasons.

Therefore, statement (iv) can be logically inferred.

Hence, the correct option is (C).

6.49 (D)

The given passage indicates that Hindi cinema is taking an interest in tribal characters but it does not mean that tribal characters have been completely accepted in the industry.

In the sentence, "None of this, though, is to say that the tribal hero has arrived in Hindi cinema", use of 'arrived' indicates that tribal characters have not attained a certain status yet.

Hence, the correct option is (D).

6.50 (C)

The given passage indicates that even though use of new cotton technology is not legal in India,

farmers are still buying herbicide tolerant cotton at an average of Rs.200 more than ordinary cotton which means farmers want to access the new technology even if it is not legal.

Hence, the correct option is (C).

6.51 (A)

As it is clearly mentioned in the given passage that Hindi film protagonists **usually** read books of aspirational value which means there is a possibility that they read other books as well. So, statement mentioned in option (A) cannot be inferred from the passage.

Hence, the correct option is (A).

6.52 (B)

In the given passage, nowhere it is mentioned that who is responsible for duping the tribal.

Therefore, it can not be inferred.

Hence, the correct option is (B).

6.53 (B)

As it is stated in the passage that state fails in protecting citizens who fall through the security net i.e. state is not providing enough welfare schemes for its people, which is the underlying or hidden reason that beggars are created.

Hence, the correct option is (B).

6.54 (D)

It is given at the starting of the paragraph that the Indian history written by British historians was extremely well documented and researched but not always impartial which means it was sometimes biased.

Hence, the correct option is (D).

6.55 (B)

In the given passage, it is not mention whether all or a few or a lot of men and women are prone to buying on impulse. So the use of 'some' is appropriate.

Hence, the correct option is (B).

6.56 (C)

When the reserve bank of India reduced repo rate, the banking institutions made demands to reduce interest rate on small saving schemes. Government took their demands into consideration and announced a deduction in interest rates on small saving schemes. Only option (C) describes the essence of above passage.

Hence, the correct option is (C).

6.57 (C)

According to the passage,

Style	Reference
Dhrupad	Baanis
Gayaki	Vocal
Baaj	Instrumental
Gharana	Lineage

Hence, the correct option is (C).

6.58 (D)

The Prestige of a kingdom depended upon number of taxes that it can charge or collect from its people which is similar to prestige of head-hunter. The head hunter is someone who collects head. So, the prestige of a head hunter depends upon the number of heads he can collect.

Hence, the correct option is (D).

6.59 (C)

Given : If the statement is true then prisoner is hanged and if the statement is false then prisoners is shot.

From option (C) : I will be shot.

If the statement is true then he should be hanged but for it to be true, he has to be shot.

If the statement is false then he should be shot but for it to be false, he has to be hanged.

Therefore, the judge will have no option but to set him free.

Hence, the correct option is (C).

6.60 (A)

Mobuto changed the name of the country and the river to Zaire with the objective of Africanising names of person and space but Zaire was a Portuguese alteration which indicates that Mobuto was not entirely successful in Africanising the name of his country.

Hence, the correct option is (A).

6.61 (B)

The writer of the passage was surprised by the creative writing assignments of his students because even though the students were Indians, all the stories were set in distant places i.e. none of the students had written stories set in India.

Hence, the correct option is (B).

6.62 (D)

It is estimated that if X's loyalty membership continues to grow at its current rate, the number of subscribers of X will outgrow that of cable television. It is based on the assumption that most of the households subscribing to X don't watch cable television any longer.

Hence, the correct option is (D).

6.63 (A)

The French speaking couple were upset as they were not able to get the announcement properly in such a short span of five seconds and they filed complaint as the announcement in English lasted for 10 seconds.

Hence the correct option is (A).

6.64 (A)

Given Holding period was 360 days in 1993 and it has changed 3 times till 2004, reducing each time by one quarter.

In 1993, Holding period = 4 Quarter

After first amendment, holding period

$$= 4 - 1 = 3 \text{ quarter}$$

After second amendment, holding period

$$= 3 - 1 = 2 \text{ quarter}$$

∴ After third revision, holding period

$$= 2 - 1 = 1 \text{ quarter}$$

Given 1 quarter = 90 days

So, holding period after third revision in 2004 is 90 days.

Hence, the correct option is (A)

6.65 (A)

By option elimination method we can say,

Statement (i) : Yes, it can be deduced from passage as "Computers are ubiquitous" given in passage.

Statement (ii) : No, it cannot be deduced because meaning of the passage did not support it.

Statement (iii) : Yes, it can be deduced as passage describes it says that "Computers are used to improve efficiency in all most all fields" is positive effect and in last line it says "Sitting in front of computer for long hours can lead health issues" is negative effect.

Statement (iv) : No, it cannot be deduced as 'AI requires data'.

Hence, the correct option is (A).

6.66 (A)

By option elimination method we can say,

Option (A) : Yes, it can be inferred from passage as it says "Cutting down on sleep to study longer hours can be counterproductive".

Option (B) : No, it cannot be inferred, as it is unrelated to passage.

Option (C) : No, it cannot be inferred as it refute the passage.

Option (D) : No, it cannot be inferred as it did not coordinate with passage.

Hence, the correct option is (A).

6.67 (A)

Given :

As we are directed to do logical negation, of given statement, situation of “either or” will become “Neither-nor” as :

$$P = Q \quad X = Y$$

$$\text{Negation : } P \neq Q \quad X \neq Y$$

Hence, the correct option is (A).

6.68 (D)

By option elimination method we can say,

Option (A) : Is not correct, as written in the passages these are related skills.

Option (B) : It can't be correct, as mentioned in the passages “so far as we know, no other species possesses this ability”.

Option (C) : It is totally wrong about the passage.

Option (D) : Yes, It is correct as given in the above passages “so far as we know, no other species possesses this ability”.

As given in the above passage “so far as we know, no other species possesses this ability”. By this we can conclude option D is correct.

Hence, the correct option is (D).

6.69 (C)

If we go through with options then option (C) is correct as mentioned in the passage “No less important for public speakers to rehearse their talks” states rehearsing is important for musicians, actors and public speakers.

Hence, the correct option is (C).

6.70 (A)

As increased consumption of leafy vegetables is directly proportional to healthy lifestyle. So, it

can be inferred that leading a healthy lifestyle is related to diet with leafy vegetables.

Hence, the correct option is (A).

6.71 (A)

As per the data given in above statement, the primary benefits for oxpeckers and rhinos respectively are

Option (A) : Oxpeckers get a food source, rhinos may be saved from the poachers.

Hence, the correct option is (A).

6.72 (B)

By option elimination method we can say,

Option (D) is wrong, as second sentence does not contradict the first sentence.

Option (A) is also wrong, as two sentences are related to each other.

Option (C) is also wrong, as the second sentence does not repeat the first one.

Hence, only **Option (B)** is correct, which shows the result of the cause.

Hence, the correct option is (B).

6.73 (C)

For summarizing the passage, the best suitable option is (C).

As superficially means apparently/seemingly.

Hence, the correct option is (C).

6.74 (A)

By option elimination method we can say,

Option (A) is absolutely correct, as mentioned in the passage “Listening to music during exercise improves exercise performance” and last two statements supports that “positive effects only in some students”.

Hence, the correct option is (A).

6.75 (D)

According to the given information,

Option (A); can not be inferred as metrics are counterproductive in organization with poor work culture.

Option (B); can not be inferred as metrics are counterproductive in organization with poor work culture not good work culture.

Option (C); can not be inferred as metrics help improve outcomes, in organization with good work culture.

Option (D); can be inferred as metrics are useful in organization with good work culture, is mentioned.

Hence, the correct option is (D).

6.76 (B)

Option (A), can not be inferred as here guilty and empathy are used in opposite tone but in passage they are used in similar tone.

Option (B), can be inferred as it is clearly mentioned the term 'due to group identification but not empathy'.

Option (C), can not be inferred as in this option again empathy and guilty are used in different tone.

Option (D), can not be inferred as in this option familiarity is used in negative tone and in passage it is given in positive tone.

Hence, the correct option is (B).

6.77 (B)

Option (A), in this option, it is mentioned that "genetically modified mosquitoes are better than using chemical to kill mosquitoes" which is not mentioned in the given passage and that's why this option is eliminated.

Option (B), in this option, it is clearly mentioned in given passage that "using chemical to kill mosquitoes may have undesired consequences

but it is not clear if using genetically modified mosquitoes has any negative consequence" so this option is correct.

Option (C), in this option, it is mentioned "genetic engineering is dangerous" which is not mentioned so this option is also eliminated.

Option (D), in this option, it is mentioned that "both using genetically modified mosquitoes and chemicals have undesired consequence and can be dangerous" which is not related to given passage so this option is also eliminated.

Hence, the correct option is (B).

6.78 (C)

Given : Option (A), this can not be inferred as it says 'GSR only grows in an extreme weather' which is not mention in the given passage.

Option (B), this can not be inferred, there is no information provided related to "good yields" in the given passage.

Option (C), this can be inferred as it is clearly mention in the given passage that "GSR is for future purpose in response to adverse effects of climate change".

Option (D), this can not be inferred, there is no information provided related to "quantity of production" in the given passage.

Hence, the correct option is (C).

6.79 (A)**6.80 MTA**

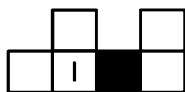
Given : A cube made by folding a single sheet of paper of appropriate shape.

The interior faces of the cube are all blank, the exterior faces that are not visible in the above view may not be blank.



By cross checking the options we can find the possible unfolding of the cube.

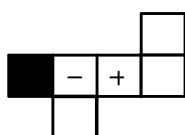
According to option (A) :



This cannot be the possible unfolding of the cube, as this  combination is not possible, after unfolding the cube combination should  looks like this.

The same combination is given in option (C) and (D), so that they are also not possible unfolding of the cube.

According to option (D) :



This combination is also not possible, as when we unfolding the folded dice looks like  this.

The unfolded dice will look like  this but in option (D) it is given as  this, which is not possible.

Hence, all the given options are not the possible unfolding of the cube.

[Note : According to IIT Kharagpur this question is marked as Marks To All (MTA)]

6.81 (D)

Option (A) is eliminated as in this it is given that “fewer people are visiting the malls but spending more” which is opposite to the given paragraph, in this paragraph it is mention that more people are visiting the mall but spending less.

Option (B) is also eliminated as in this option “fewer people” is mention but in paragraph more people are visiting the mall.

Option (C) is also eliminated as per paragraph more people are visiting the mall but they are not spending well but in this option spending more is given which is wrong.

Option (D) is correct as in the paragraph it is clearly mention that more people are visiting mall but revenue generated is not enough.

Hence, the correct option is (D).

6.82 (B)

Option (A) is eliminated as in this paragraph there is nothing mention regarding people’s opinion whether they do care about money more or not.

Option (B) is correct logical inference as wallets with a key are more likely to be returned because people relate to suffering of others as mentioned in the passage “the primary reason for this behavior is compassion and empathy”.

Option (C) is eliminated as there is no comparison between the experiment and real instance of lost wallet in paragraph.

Option (D) is eliminated as this no comparison between the importance of money and key is given in the paragraph.

Hence, the correct option is (B).

6.83 (C)

Option (A), the word ‘only’ is mentioned that having ultra black skin the only advantage to species S which is not given in the paragraph so this option is eliminated.

Option (B), it is mention in paragraph that with lower collagen on the skin makes it weak which is disadvantage not advantage so this option is eliminated.

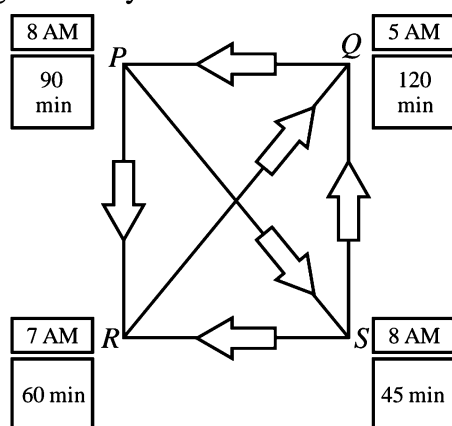
Option (C) in paragraph both advantage to avoid predators and can attack their prey is given and disadvantage of their skin become more fragile is given so this option is correct.

Option (D) the word 'only' is mentioned with disadvantage where in paragraph advantages of having ultra black skin is also given so option (D) is also eliminated.

Hence, the correct option is (C).

6.84 (A)

Given : Four cities P, Q, R and S are connected through one-way routes as shown in the figure,



The boxes beside each city name describe the starting time of first train of the day and their frequency of operation.

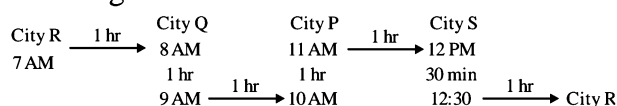
For example, from city P, the first trains of the day start at 8 AM with a frequency of 90 minutes to each of R and S.

A person does not spend additional time at any city other than the waiting time for the next connecting train.

If the person starts from R at 7 AM and is required to visit S and return to R, the minimum time required will be calculated as,

Here, the travel time between any two connected cities is one hour and waiting time at any city is different and according to the city shown in above figure.

Hence, the total journey time from city R to city S and return to city R is calculated as shown in below figure.



City R to city Q travel time is 1 hour.

Waiting time at city Q for next train is 1 hour.

City Q to city P travel time is 1 hour.

Waiting time at city P for next train is 1 hour.

City P to city S travel time is 1 hour.

Waiting time at city S for next train is 30 min.

City S to city R travel time is 1 hour.

Here, the minimum time required for traveling from city R to visit city S and return to city R is,

$$RQ + \bar{Q} + QP + \bar{P} + PS + \bar{S} + SR$$

1h + 1h + 1h + 1h + 1h + 30m + 1h = 6 hours 30 minutes

Hence, the correct option is (A).

6.85 (B)

Given : The parts of the coherent paragraphs are given in the options.

Let's analyse each option

From option (Q) : "In natural world, organisms constantly adapt to their environments in response to challenges and opportunities."

This serves the best opening sentence, introducing the general idea of adaption in nature.

Hence, option (Q) acts as introduction of the coherent paragraph.

From option (S) : "As environments change, organisms that can adapt their behavior, structure and physiology to such changes are more likely to survive".

This logically follows statement Q, explaining how organisms adjust to environmental changes.

From option (R) : "This process of adaptation is driven by the principle of natural selection, where favorable traits increase an organism's chances of survival and reproduction."

This statement introduces the mechanism behind adaption and natural selection.

This logically follows statement S, explaining the natural selection as driving force.

From option (P) : “Over time, such adaptations lead to significant evolutionary changes with the potential to shape the development of new species.”.

This statement provides the final (closing) statement, explaining the long term consequence of adaption.

Hence, the logical sequence of the statements such that a coherent paragraph is formed is

$$Q \rightarrow S \rightarrow R \rightarrow P$$

Hence, the correct option is (B).

6.86 (C)

Given : The parts of the coherent paragraph is given in the options.

Let's analyse each option

From option (Q) : “Tigers spend most of their life searching for food.”

This serves as the best opening statement.

It introduces the main idea that tigers spend most of their life searching for food.

Hence, option (Q) acts as introduction of the coherent paragraph

From options (S) : “For several night, they relentlessly prowl through the forest, hunting for a trail that may lead to their prey.

This logically follows statement Q, explaining how tiger prowl through forests for several nights hunting.

From option (R) : “If they trace the scent of deer, tigers follow the trail, chase the deer for a mile or two in the dark and yet may not catch them”.

This statement explains how tigers follow the scent and chase deer but may not catch them.

This logically follows statement S.

From option (P) : “It is because deer, like most of the animals that tigers normally prey on, run much faster! It simply means, another day of empty stomach for the big cats”.

This logically follows statement R explaining how why tigers often fail b/c deer run much faster.

Hence, the logical sequence of statements such that a coherent paragraph is formed is

$$Q \rightarrow S \rightarrow R \rightarrow P$$

Hence, the correct option is (C).

6.87 (B)

Given : “Even if I had known that you were in the hospital, I would not have gone there to see you,” Ramya told Josephine.

Step-by-Step Analysis :

1. The phrase “Even if I had known...” implies that Ramya did not actually know Josephine was in the hospital at that time.
2. The phrase “...I would not have gone there to see you.” suggests that even if she had known, she would still not have visited.
3. The key logical inference is about Ramya's knowledge of Josephine's situation.

From Option (A) : Incorrect, because Ramya explicitly implies that she did not know.

From Option (B) : Correct, since the phrase “Even if I had known...” confirms that she was unaware.

From Option (C) : Incorrect, as the conversation does not mention their past friendship.

From Option (D) : Incorrect, as nothing in the statement specifies why Josephine was in the hospital.

Hence, the correct option is (B).

6.88 (B)

The passage discusses how wealthier nations are demolishing crooked streets in their capital and towns without understanding why they are

doing. So it contrast modern urban planning with historical preservation.

From option (A) : The author of the passage takes delight in wondering. **(Incorrect)**

The author is not expressing joy but rather concern and confusion about the destruction of crooked streets.

From option (B) : The wealthier nations are pulling down the crooked streets in their capitals. **(Correct)**

The passage explicitly states that wealthier nations are demolishing these streets, aligning with the given statement.

From option (C) : In the past, crooked streets were only built on islands. **(Incorrect)**

The passage does not state that crooked streets were limited to islands.

It only mentions "the islands of the past" metaphorically.

From option (D) : Great broad ways are needed to protect commerce and history. **(Incorrect)**

While the passage mentions broad roads for commerce, it criticizes them for erasing history rather than protecting it.

Hence, the correct option is (B).

6.89 (A)

Analyzing the passage : The phrase "His life was divided between the books, his friends, and long walks" suggests a solitary, studious life.

"Probably courted his fatal illness" strongly indicates that he died.

"To his own name there is not much to show" suggests he was not widely recognized.

"Fruits of his erudition are widely scattered" means his knowledge benefited others.

From option (A) : The solitary man described in the passage is dead. **(Correct)** the passage states that he "courted his fatal illness," indicating his death.

From option (B) : Strangers helped create a grand reputation for the solitary man. **(Incorrect)** the passage says he helped others gain recognition, not the other way around.

From option (C) : The solitary man found joy in scattering fruits. **(Incorrect)** "Fruits of his erudition" refers to his knowledge, not literal fruits.

From option (D) : The solitary man worked in a court where he fell ill. **(Incorrect)** no mention of working in a court is made in the passage.

Hence, the correct option is (A).

6.90 (D)

Paragraph Arrangement

We need to find the most coherent sequence of sentences.

S introduces the discovery of gold in Kolar and how the news spread.

P follows logically, describing the immediate reaction of people rushing to the city.

Q explains the difficulties they faced, which makes sense after P.

R concludes the paragraph by summarizing their belief that they would become wealthy.

Thus, the correct order is :

$S \rightarrow P \rightarrow R \rightarrow Q$ (Option D).

Hence, the correct option is (D).

6.91 (C)

According to the above passage. The pocket knife is described as the infant of the sword.

Hence, the correct option is (C).

6.92 (C)

The conclusion that "if all students are standing, then the teacher must be in the room" is not necessarily true.

Students might be standing for entirely different reasons even when the teacher is absent.

Hence, the correct option is (C).

6.93 (B)

The passage notes that combinatorics is sometimes used in modeling physical phenomena, not always. Therefore, statement *P*, which claims it is always invoked, is false.

The passage also explicitly states that in some models, probabilities are assigned to combinatorial possibilities to compute the average values of physical quantities. This directly supports statement *Q*, making it true.

Because *P* is false and *Q* is true, the correct answer is option (B).

Hence, the correct option is (B).

6.94 (D)

Given statement :

$$P \rightarrow Q$$

This only tells if success $\rightarrow$ enough money.

It does not guarantee :

- The movie was successful
- He made enough money
- He will sponsor the next movie

Thus A, B, C cannot be concluded.

The only reasonable inference from the context of the conditional statement is that the movie was not commercially successful.

Hence, the correct option is (D).

Engineering Services Examination (ESE)

1. (A)

Step 1 : Make proper drafting of given information :

$$\begin{aligned} A &> B \\ C &\approx D \\ E &< F \\ B &> C \\ F &< D \end{aligned}$$

Step 2 : Make possible arrangements according to drafted information we get :

$$A > B > C/D > F > E$$

According to the arrangement E scored lowest.

Hence, the correct option is (A).

2. (D)

	Families	Qualification	Studies	Interest	Hard work
A	Rich	PG	Good	Acting	Not
B	Middle	UG	Average	Music	Industrious
C	Poor	UG	Poor	Sports	Industrious
D	Middle	UG	Avg	Acting	Not
E	Poor	PG	Good		Industrious

Hence the correct option is (D).

3. (D)

Given :

1. If program P is to be operated on a day, V cannot be operated on that day.
2. If Q is to be operated on a day, T must be one of the programs to be operated after Q.
3. If R is to be operated on a day, V must be one of the programs to be operated after R.
4. The last program to be operated on any day must be either S or U.

Conditions that follows :

Options	Possible Combination	Reasons
1.	Q.V.S	Not possible, According to the condition 2. <i>T</i> must be operated one of the days after <i>Q</i> and <i>T</i> is not in the combination here.
2.	Q.T.V	Not possible, according to conditions 4, the last program to be operated on any day must either <i>S</i> or <i>U</i> .

3.	T.S.U	Not possible according to the condition 2. Set R and W are operated on 1 st day thus according to condition 3, V must be one of the program to be operated after R . but here V is not present.
4.	T.S.V	Possible it follows condition 3 and 4 do not violate any given condition.

Hence, the correct option is (D).

4. (B)

We first form the sequence of visit using (4), (5) and (6).

From (4), Q visits first and U visit last.

From (5), W visits first after break and is followed by R .

From (6), P visits after break.

Thus, the sequence of visit after break becomes W, R, P, U . Also, S has the same position in morning session as P in afternoon session.

So, sequence of visit before break is $Q, T/V, S, V/T$. As mentioned, lunch break will be over and doctor W will visit at 1.45 pm, doctor R will visit at 2.30 pm, doctor P will visit at 3.15 pm and U will visit at 4 pm.

Hence the correct option is (B).

5. (C)

One couple is QP .

Now, R and U are the children of T . So the other couples is TS .

T is a Teacher.

S is a female doctor.

Q is a Lawyer.

Obviously P is a housewife.

S is the mother of R and U .

P has one son and one grandson.

Clearly, T is the son of P and R or U is the grandson.

The grandson is a male engineer and the granddaughter is a student.

R may be the brother or sister of U .

Hence the correct option is (C).

6. (D)

	Dramatics	C.S.	Physics	History	Maths
Madhu	✓	✓	✓		
Shobha	✓	✓		✓	
Anjali		✓	✓	✓	✓
Poonam	✓		✓	✓	
Nisha			✓	✓	✓

Only Anjali good in History, Physics, C.S. and Maths.

Hence the correct option is (D).

7. (A)

Sociology is on the top of all books. Accountancy is immediately below education. Which is immediately below sociology. Economics is immediately above psychology but not in the middle. Hindi is immediately below psychology.

- **Sociology (Top)**
- Education
- Accountancy
- English
- Economics
- Psychology
- **Hindi (Bottom)**

Hence the correct option is (A).

8. (D)

Descending order of Heights and ages is as
Given below.

Height : Madhavi > Hasini > Neelam > Pooja >
Pranati

Age : Neelam > Madhavi = Pranati > Hasini =
Pooja

Hence the correct option is (D).

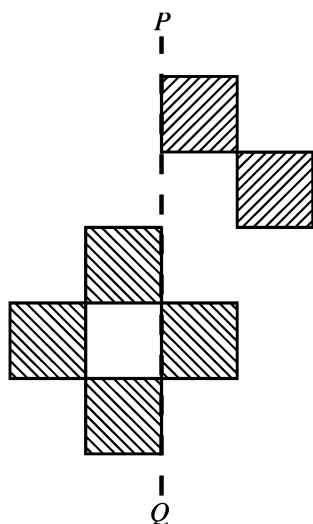


CHAPTER 4 | SPATIAL APTITUDE

Syllabus :

Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping Paper folding, cutting, and patterns in 2 and 3 dimensions.

1.



The least number of squares that must be added so that the line $P-Q$ becomes the line of symmetry is ____.

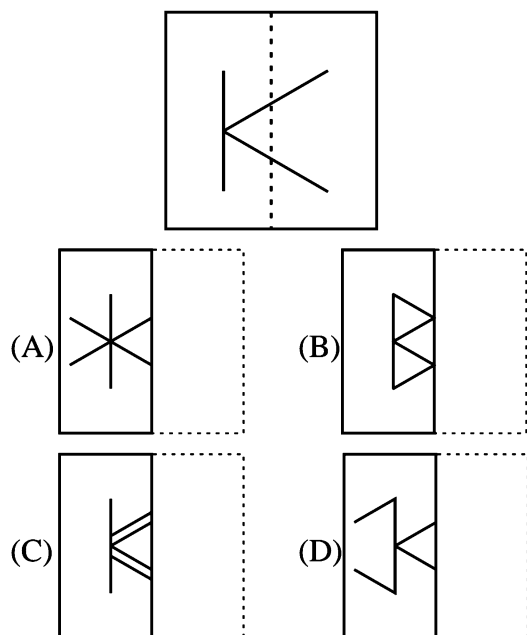
[EC, ES, PE, PI, ST]

- (A) 4 (B) 7
(C) 6 (D) 3

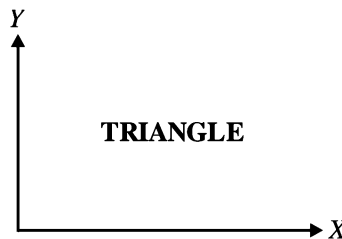
2.

A transparent square sheet shown below is folded along the dotted line. The folded sheet will look like ____.

[AG, EE, EY, GG]



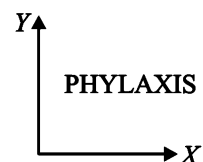
3.



The mirror image of the above text about the X-axis is [CE-1, CY, IN]

- (A) TRIANGLE (B) TRIANGLE
(C) TRIANGLE (D) TRIANGLE

4.

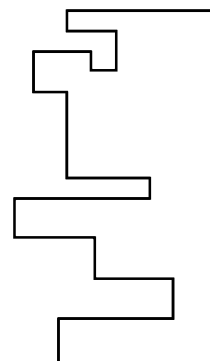


The mirror image of the above text about the X-axis is

[AE, AR, BM, CE-2, MN, PH]

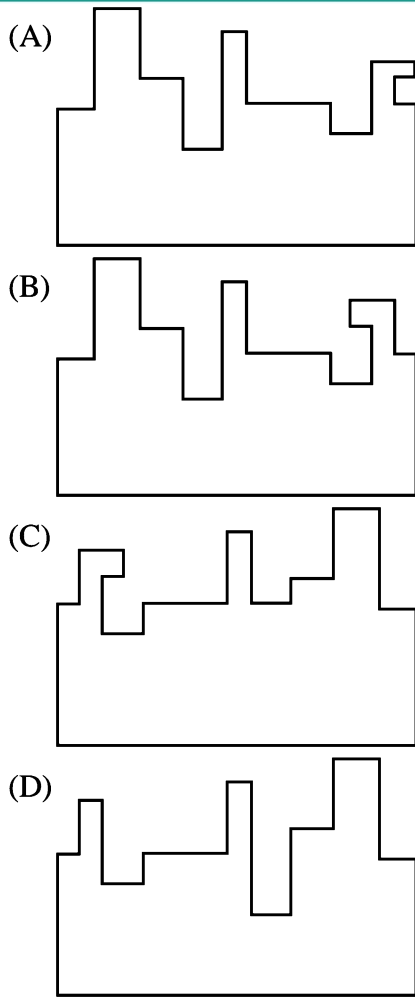
- (A) PHYLAXIS
(B) PHYLAXIS
(C) PHYLAXIS
(D) PHYLAXIS

5.

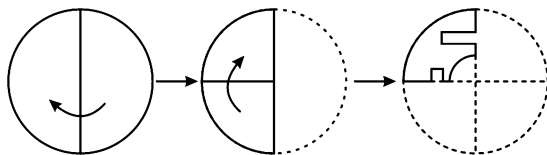


A jigsaw puzzle has 2 pieces. One of the pieces is shown above. Which one of the given options for the missing piece when assembled will form a rectangle? The piece can be moved, rotated or flipped to assemble with the above piece.

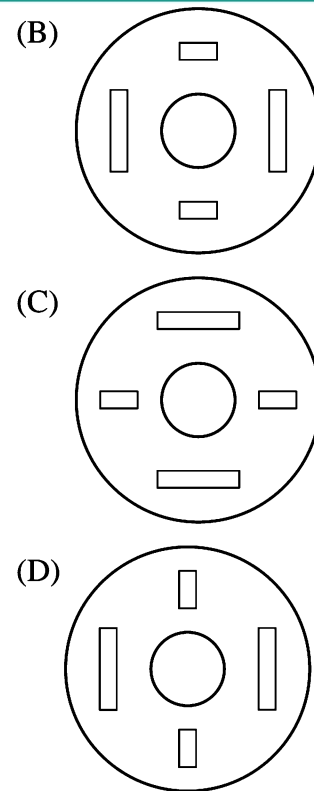
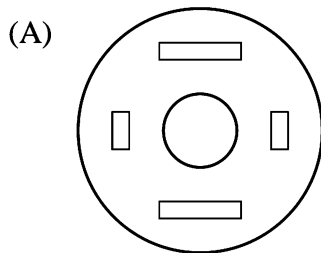
[ME-1, XH]



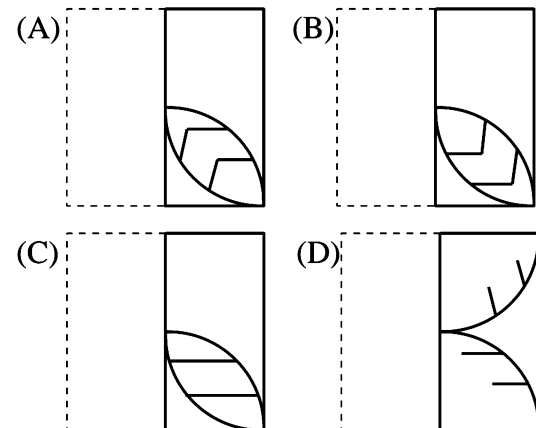
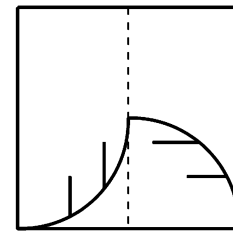
6.



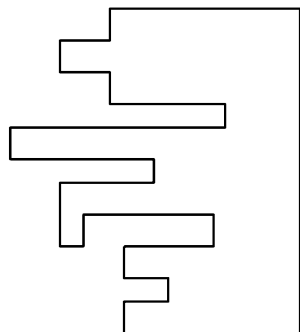
A circular sheet of paper is folded along the lines in the directions shown. The paper, after being punched in the final folded state as shown and unfolded in the reverse order of folding, will look like _____. [BT, CH, CS-1, MA, TF]



7. A transparent square sheet shown below is folded along the dotted line. The folded sheet will look like _____. [CS-2, XE, XL]

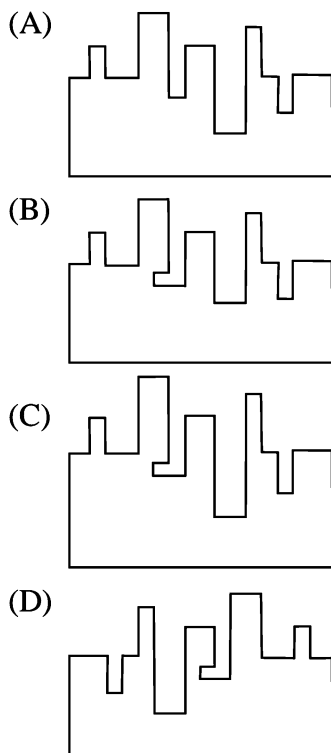


8.



A jigsaw puzzle has 2 pieces. One of the pieces is shown above. Which one of the given options for the missing piece when assembled will form a rectangle? The piece can be moved, rotated or flipped to assemble with the above piece.

[CS-2, XE, XL]



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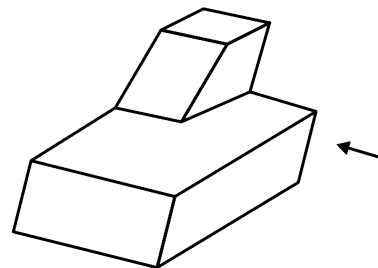
9. Two straight lines pass through the origin $(x_0, y_0) = (0, 0)$. One of them passes through the point $(x_1, y_1) = (1, 3)$ and the other passes through the point (x_2, y_2)

$= (1, 2)$. What is the area enclosed between the straight line in the interval $(0, 1)$ on the x-axis?

[CE-1]

- (A) 1.5 (B) 0.5
(C) 2.0 (D) 1.0

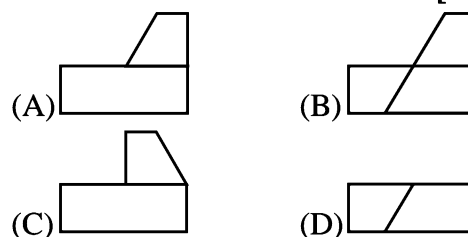
10.



A block with a trapezoidal cross-section is placed over a block with rectangular cross section as shown above.

Which one of the following is the correct drawing of the view of the 3D object as viewed in the direction indicated by an arrow in the above figure?

[ME-1]



11. A rhombus is formed by joining the midpoints of the sides of a unit square. What is the diameter of the largest circle that can be inscribed within the rhombus?

[ME-1]

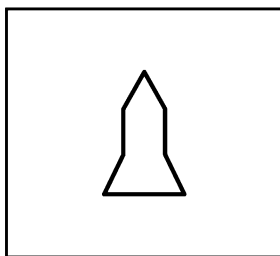
- (A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2\sqrt{2}}$
(C) $\sqrt{2}$ (D) $2\sqrt{2}$

12. An equilateral triangle, a square and a circle have equal areas. What is the ratio of the perimeters of the equilateral triangle to square to circle?

[ME-1]

- (A) $3\sqrt{3} : 2 : \sqrt{\pi}$
 (B) $\sqrt{(3\sqrt{3})} : 2 : \sqrt{\pi}$
 (C) $\sqrt{(3\sqrt{3})} : 4 : 2\sqrt{\pi}$
 (D) $\sqrt{(3\sqrt{3})} : 2 : 2\sqrt{\pi}$

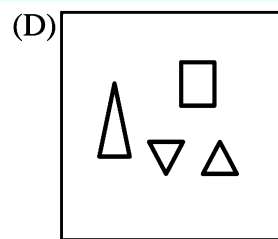
13.



Which one of the groups given below can be assembled to get the shape that is shown above using each piece only once without overlapping with each other? (rotation and translation operations may be used).

[ME-2]

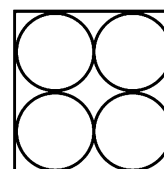
- (A)
- (B)
- (C)



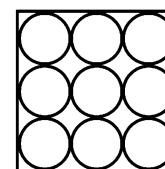
14. Equal sized circular regions are shaded in a square sheet of paper of 1 cm side length. Two cases, case M and case N, are considered as shown in the figures below. In the case M, four circles are shaded in the square sheet and in the case N, nine circles are shaded in the square sheet as shown.

What is the ratio of the areas of unshaded regions of case M to that of case N?

[ME-2]



Case M



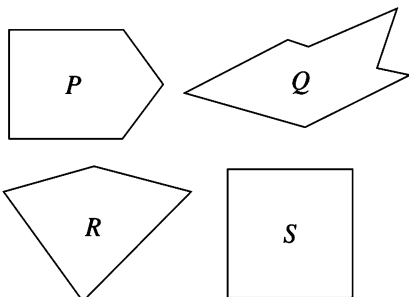
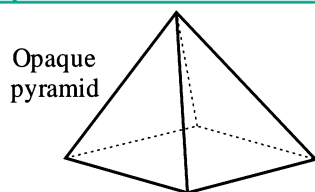
Case N

- (A) 2 : 3
 (B) 1 : 1
 (C) 3 : 2
 (D) 2 : 1

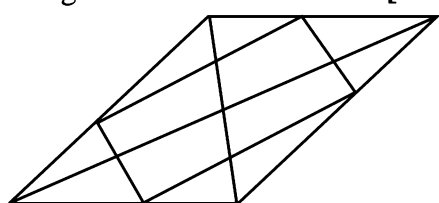
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15. An opaque pyramid (shown below), with a square base and isosceles faces, is suspended in the path of a parallel beam of light, such that its shadow is cast on a screen oriented perpendicular to the direction of the light beam. The pyramid can be reoriented in any direction within the light beam. Under these conditions, which one of the shadows P, Q, R, and S is NOT possible?

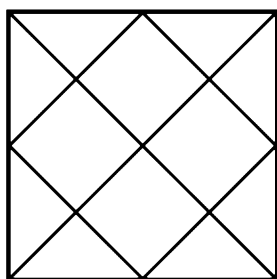
[ME]



- (A) P (B) Q
(C) R (D) S
16. How many triangles are present in the given figure? [EE]

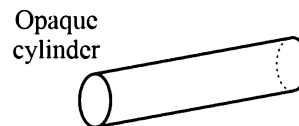


- (A) 12 (B) 16
(C) 20 (D) 24
17. How many rectangles are present in the given figure? [ECE]



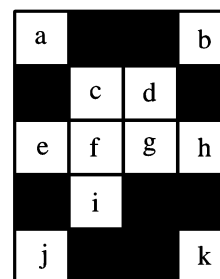
- (A) 8 (B) 9
(C) 10 (D) 12
18. An opaque cylinder (shown below) is suspended in the path of a parallel beam of light, such that its shadow is cast on a screen oriented perpendicular to the direction of the light beam. The cylinder can be reoriented in any direction within

the light beam. Under these conditions, which one of the shadows P , Q , R and S is NOT possible? [IN, XE]

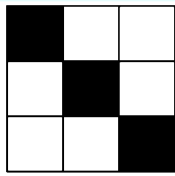


- (A) P (B) Q
(C) R (D) S
19. A line of symmetry is defined as a line that divides a figure into two parts in a way such that each part is a mirror image of the other part about that line.
- The figure below consists of 20 unit squares arranged as shown. In addition to the given black squares, upto 5 more may be coloured black. Which one among the following options depicts the minimum number of boxes that must be coloured black to achieve two lines of symmetry? (The figure is representative)

[CE-1]

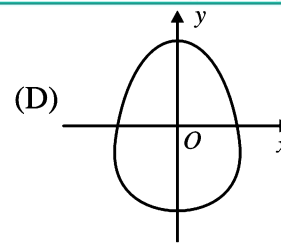
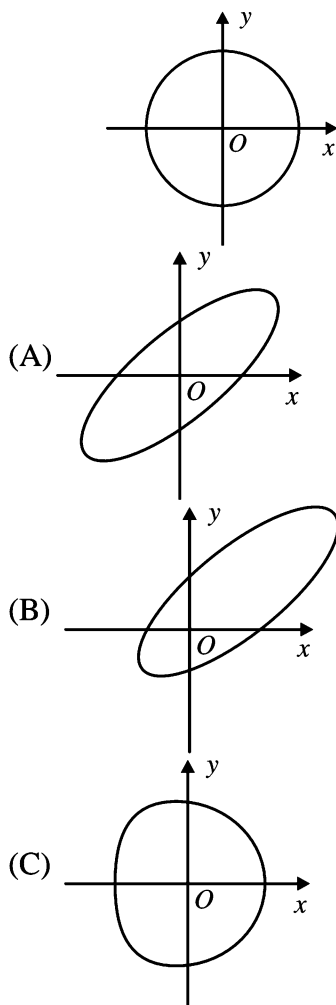


- (A) d (B) c, d, i
(C) c, i (D) c, d, i, f, g
20. In how many ways can cells in a 3×3 grid be shaded, such that each row and each column have exactly one shaded cell? An example of one valid shading is shown. [CE-2]

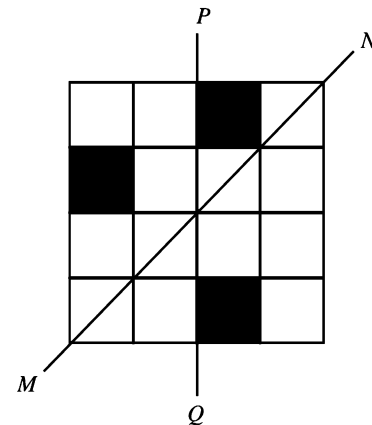


- (A) 2 (B) 9
(C) 3 (D) 6
21. Consider a circle with its centre at the origin (O), as shown. Two operations are allowed on the circle.
- Operation 1 :** Scale independently along the x and y axes.
- Operation 2 :** Rotation in any direction about the origin.
- Which figure among the options can be achieved through a combination of these two operations on the given circle?

[CE-2]



22. A line of symmetry is defined as a line that divides a figure into two parts in a way such that each part is a mirror image of the other part about that line.
- The given figure consists of 16 unit squares arranged as shown. In addition to the three black squares, what is the minimum number of squares that must be coloured black, such that both PQ and MN form lines of symmetry? (The figure is representative) [CH, PI]

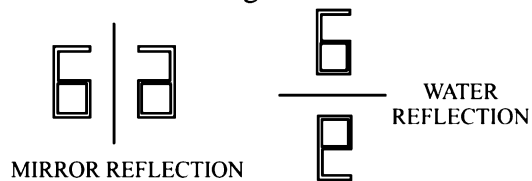


- (A) 3 (B) 4
(C) 5 (D) 6
23. Which one of the following shapes can be used to tile (completely cover by repeating) a flat plane, extending to infinity in all directions, without leaving any empty spaces in between them? The copies of the shape used to tile are identical and are not allowed to overlap. [CH, PI]
- (A) circle
(B) regular octagon
(C) regular pentagon
(D) rhombus

2024

IISc Bangalore

24. Examples of mirror and water reflections are shown in the figures below :



MIRROR REFLECTION

An object appears as the following image after first reflecting in a mirror and then reflecting on water

5.24

The original object is

- (A) (B)
- (C) (D)

[ECE]

25. Five cubes of identical size and another smaller cube are assembled as shown in Figure A. If viewed from direction X, the planar image of the assembly appears as Figure B.

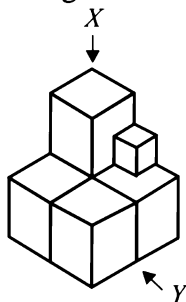


Figure A

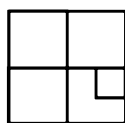
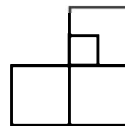


Figure B

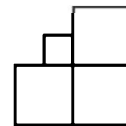
If viewed from direction Y, the planar image of the assembly (Figure A) will appear as

- (A) (B)

(C)

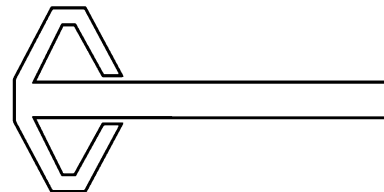


(D)

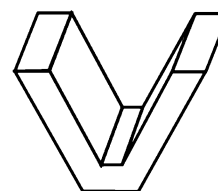


[IN, CE-2]

26. A planar rectangular paper has two V-shaped pieces attached as shown below :



This piece of paper is folded to make the following closed three-dimensional object.

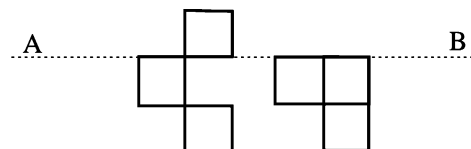


The number of folds required to form the above object is :

- (A) 9 (B) 7
(C) 11 (D) 8

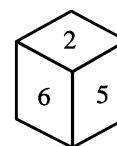
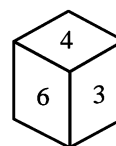
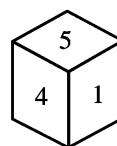
[ME]

27. The least number of squares to be added in the figure to make AB a line of symmetry is

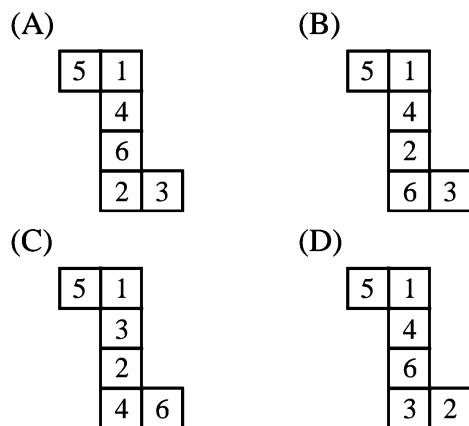


- (A) 6 (B) 4
(C) 5 (D) 7

28. Three different views of a dice are shown in the figure below.



The piece of paper that can be folded to make this dice is

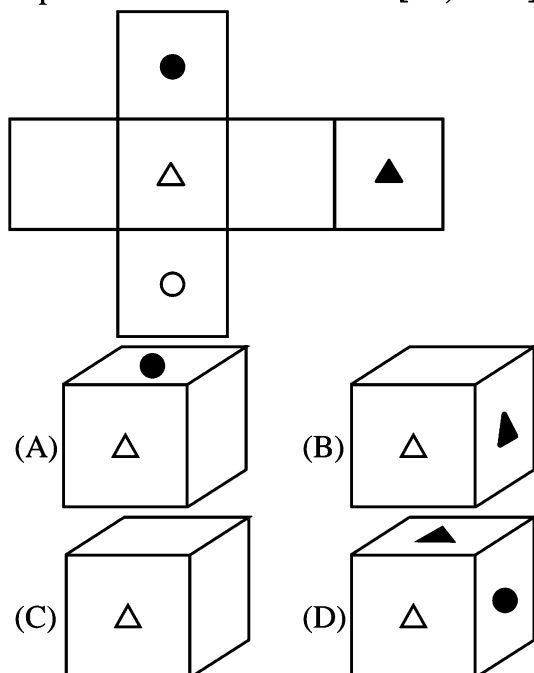


[PI, DA]

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29. The paper as shown in the figure is folded to make a cube where each square corresponds to a particular face of the cube. Which one of the following options correctly represents the cube?

Note : The figures shown are representative. [IN, CS-2]

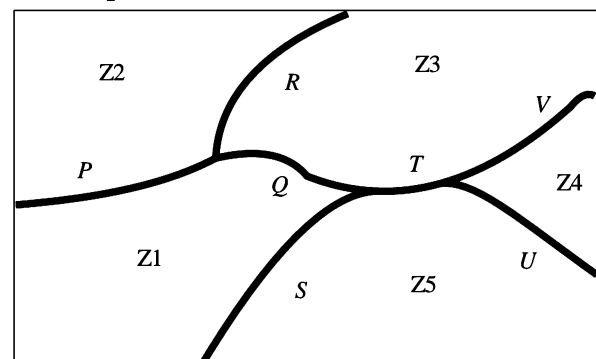


30. The diagram below shows a river system consisting of 7 segments, marked P, Q, R, S, T, U, and V. It splits the land into 5

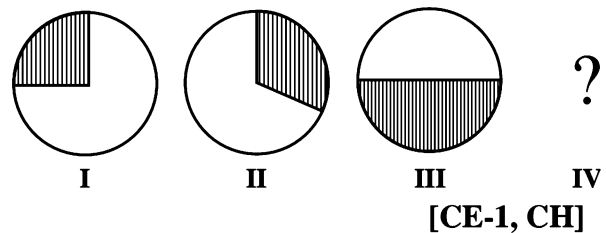
zones, marked Z1, Z2, Z3, Z4, and Z5. We need to connect these zones using the least number of bridges. Out of the following options, which one is correct?

[IN, CS-2]

Note : The figure shown is representative.



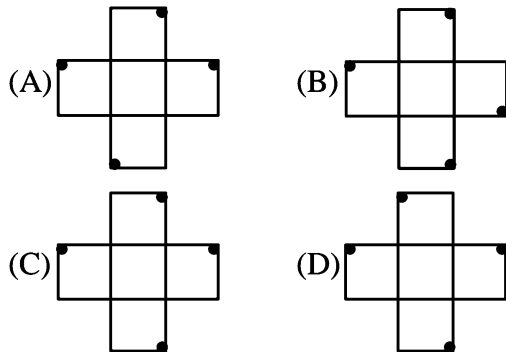
- (A) Bridges on P, Q, and T
 (B) Bridges on P, Q, S, and T
 (C) Bridges on Q, R, T, and V
 (D) Bridges on P, Q, S, U, and V
31. The figures, I, II and III are parts of a sequence. Which one of the following option comes next in the sequence is IV?



- (A)
- (B)
- (C)
- (D)
32. An object is said to have an n-fold rotational symmetry if the object, rotated by an angle of $\frac{2\pi}{n}$, is identical to the original.

Which one of the following objects exhibits 4-fold rotational symmetry about an axis perpendicular to the plane of the screen? [CE-1, CH]

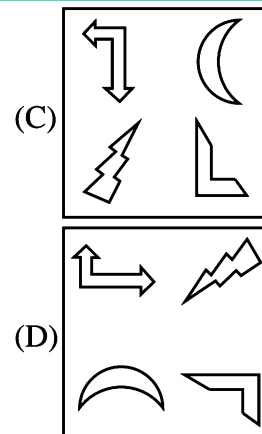
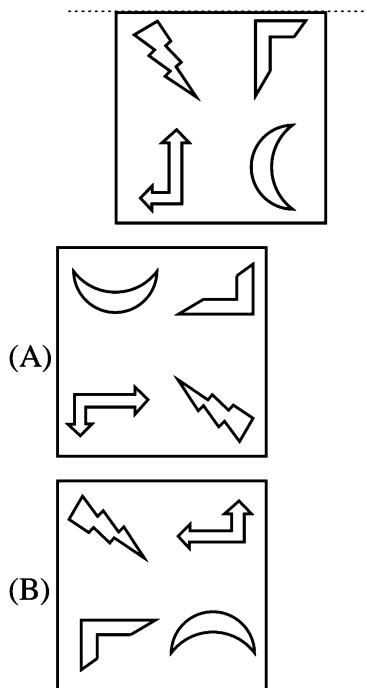
Note : The figures shown are representative.



33. The given figure is reflected about the horizontal dashed line and then rotated clockwise by 90° about an axis perpendicular to the plane of the figure.

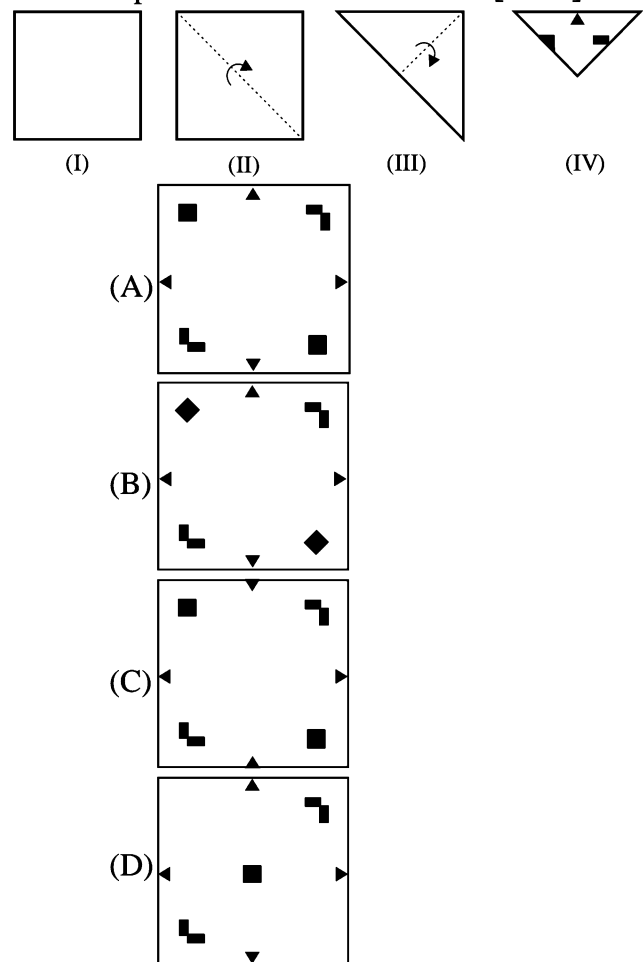
Which one of the following options correctly shows the resultant figure?

Note : The figures shown are representative. [ME, PE]



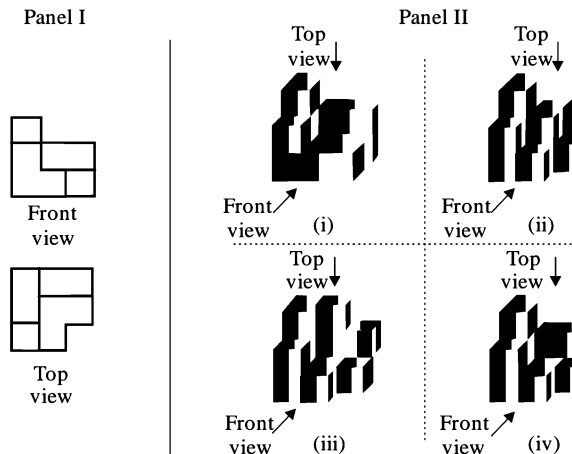
34. A square paper, shown in figure (I), is folded along the dotted lines as shown in the figures (II) and (III). Then a few cuts are made as shown in figure (IV). Which one of the following patterns will be obtained when the paper is unfolded?

Note : The figures shown are representative. [CS-1]

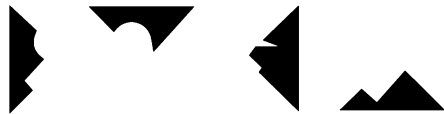


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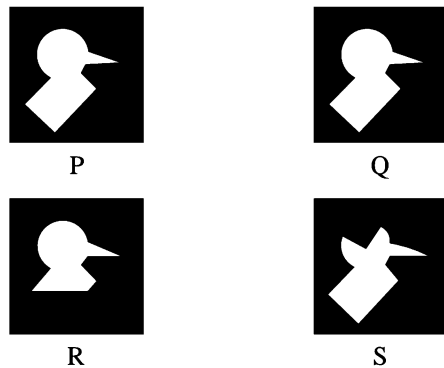
35. In Panel I of the figure below, the front view and top view of a structure are shown. Which one of the 3D structures shown in Panel II possesses the views shown in Panel I? [CS-1]



- (A) (i) (B) (ii)
(C) (iii) (D) (iv)
36. The four pieces of a puzzle are shown in the figure below. [DA]



Which one of the figures labelled as P, Q, R, and S can be constructed by using each of the four pieces only once without overlaps?



- (A) P (B) Q
(C) R (D) S

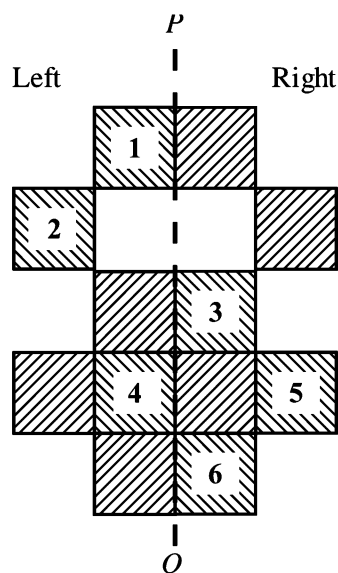
Answers	Spatial Aptitude
---------	------------------

1.	C	2.	B	3.	B	4.	C	5.	B
6.	A	7.	A	8.	B	9.	B	10.	A
11.	A	12.	B	13.	B	14.	B	15.	B
16.	C	17.	C	18.	D	19.	B	20.	D
21.	A	22.	C	23.	D	24.	A	25.	A
26.	A	27.	A	28.	A	29.	A	30.	C
31.	B	32.	B	33.	B	34.	A	35.	D
36.	A								

Explanations	Spatial Aptitude
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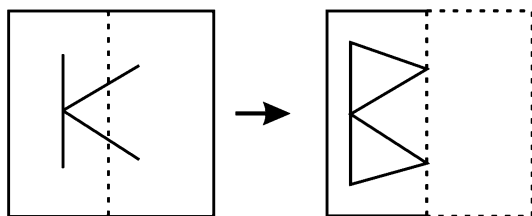
1. (C)

We have to add six square blocks to make line PQ as a line of symmetry as shown below,



Hence, the correct option is (C).

2. (B)



Hence, the correct option is (B).

3. (B)

If mirror is placed on X-axis, then the correct image is

Hence, the correct option is (B).

4. (C)

If mirror is placed on X-axis, then the correct image is

Hence, the correct option is (C).

5. (B)

For assembling the 2 pieces to form a rectangle,
First ; flip the figure to left side and rotate it to 90° clock wise direction and assume to put it on question figure.

Hence, the correct option is (B).

6. (A)

While we unfold in the reverse order of folding the punched sheet of paper step by step, the figure will look alike option (A).

Hence, the correct option is (A).

7. (A)

After folding the paper from dotted line towards right side, the figure will look alike option (A).
Hence, the correct option is (A).

8. (B)

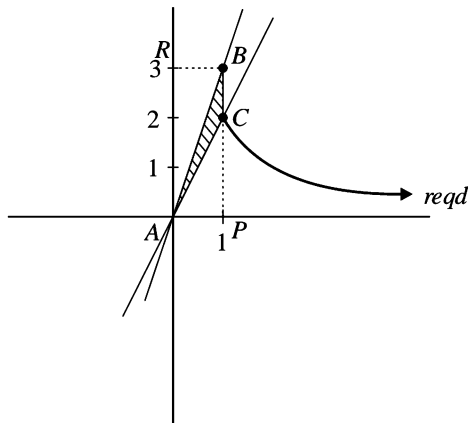
For assembling the 2 pieces to form a rectangle, First; flip the figure to left side and rotate it to 90° clock wise direction and assume to put it on question figure.
Hence, the correct option is (B).

9. (B)

Given :

Passing point of straight line 1 are $A(0, 0)$ and $B(1, 3)$

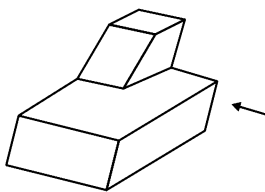
Passing point of straight line 2 are $A(0, 0)$ and $C(1, 2)$



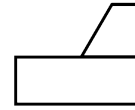
$$\begin{aligned} \text{Enclosed Area between straight line} \\ &= \text{Area}[\square APBR] - \text{Area}[\triangle ACP] - \text{Area}[\triangle ARB] \\ &= (3 \times 1) - \frac{1}{2}(1 \times 2) - \frac{1}{2} \times 3 \times 1 = 0.5 \end{aligned}$$

Hence, the correct option is (B).

10. (A)

Given :

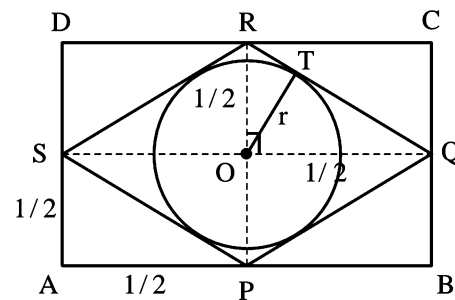
The correct drawing of the view of the 3D object as viewed in the direction indicated by an arrow,



Hence, the correct option is (A).

11. (A)

Let $ABCD$ be the square of unit length and P, Q, R, S be midpoints of AB, BC, CD, DA respectively



Let O be centre of circle

$$OR = OQ = \frac{1}{2} \text{ units}$$

$$\begin{aligned} SP &= \sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2} \quad (\text{in } \triangle SAP) \\ &= \frac{1}{2}\sqrt{2} \end{aligned}$$

$$SP = PQ = RQ = PS \quad (\text{rhombus})$$

$$\begin{aligned} \text{Area of } \triangle ORQ &= \frac{1}{2} OR \times OQ \\ &= \frac{1}{2} OT \times RQ \end{aligned}$$

$$\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{2} \times r \times RQ$$

$$r = \frac{1}{2\sqrt{2}}$$

$$\text{Diameter} = 2r = \frac{1}{\sqrt{2}}$$

Hence, the correct option is (A).

12. (B)

Let, equilateral Δ of side a Square of side b Radius of circle = r

$$\frac{\sqrt{3}a^2}{4} = b^2 = \pi r^2$$

$$b = \left(\frac{\sqrt{\sqrt{3}}}{2} \right) a$$

$$r = \left(\sqrt{\frac{\sqrt{3}}{\pi}} \right) \frac{1}{2} a$$

Ratio of perimeters, $3a : 4b : 2\pi r$

$$= 3a : \frac{4\sqrt{\sqrt{3}}a}{2} : 2\pi \sqrt{\frac{\sqrt{3}}{\pi}} \times \frac{1}{2} a$$

$$= 3 : 2\sqrt{\sqrt{3}} : \sqrt{\sqrt{3}}\pi$$

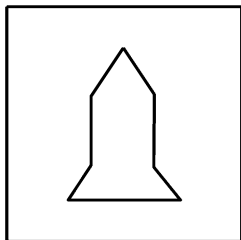
$$= 3\sqrt{\sqrt{3}} : 2\sqrt{3} : \sqrt{3}\pi$$

$$= \frac{3\sqrt{\sqrt{3}}}{\sqrt{2}} : 2 : \pi = \sqrt{3}\sqrt{3} : 2 : \sqrt{\pi}$$

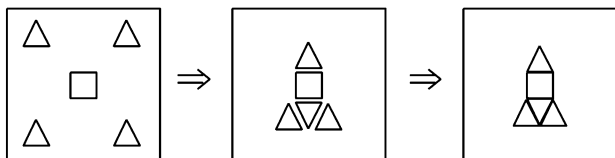
Hence, the correct option is (B).

13. (B)

Given :



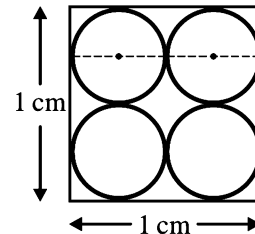
The group that can be assembled to get the shape that is shown above is, according to option (B).



Hence, the correct option is (B).

14. (B)

Case M :



From the given diagram, side of a square
 $= 2 \times \text{Diameter of a shaded circle.}$

Given side of square = 1 cm

$$\therefore \text{Diameter of a shaded circle} = \frac{1}{2} \text{ cm}$$

$$\therefore \text{Radius of shaded circle} = \frac{1}{4} \text{ cm}$$

$$\text{Area} = \frac{\pi}{16} \text{ cm}^2$$

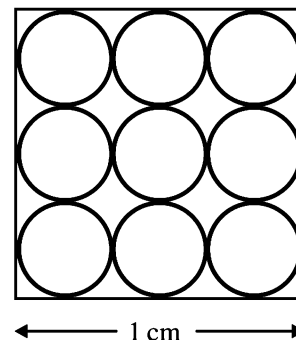
So, Area of unshaded region = Area of square
 sheet – Area of 4 shaded circular region.

 $\therefore$ Area of unshaded region

$$= \left[1^2 - 4 \times \frac{\pi}{16} \right] \text{ cm}^2 = \left[1 - \frac{22}{28} \right] \text{ cm}^2$$

$$= \frac{6}{28} \text{ cm}^2$$

Case N :



From the given diagram, side of a square
 $= 3 \times \text{Diameter of a shaded circle.}$

Given, side of square = 1 cm

$$\text{Diameter} = \frac{1}{3} \text{ and radius} = \frac{1}{6}$$

∴ Area of unshaded region of case N = Area of square sheet – Area of shaded circular region.

$$= \left[1 - 9 \times \frac{\pi}{36} \right] \text{ cm}^2 = \left[1 - \frac{22}{28} \right] \text{ cm}^2$$

$$= \frac{6}{28} \text{ cm}^2$$

∴ The ratio of the areas of unshaded region of case M to that of case N

$$= \frac{6}{28} \text{ cm}^2 : \frac{6}{28} \text{ cm}^2 = 1:1$$

Hence, the correct option is (B).

15. (B)

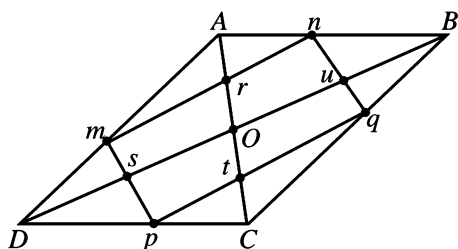
Given : An opaque pyramid with a square base and isosceles faces is suspended in the path of a parallel beam of light such that its shadow is cast on a screen oriented perpendicular to the direction of the light beam.

The pyramid can be reoriented in any direction within the light beam under these conditions the shadow Q, is not possible.

Hence, the correct option is (B).

16. (C)

Given : Number of triangles are present in the figure,



In rectangle ABCD, number of triangle are 8.

The triangles are, OAB, OBC, OCD, ODA, ADC, DCB, CBA, BAD.

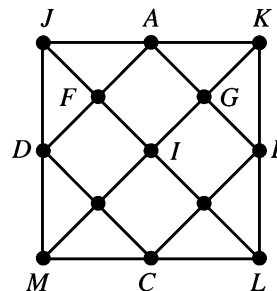
There are three triangles in mAn, mDp, pCq, qBn.

Therefore, $8 + 3 + 3 + 3 + 3 = 20$

Hence, the correct option is (C).

17. (C)

Given : In rectangle, ABCD there are 9 rectangles. AGIF, GBEI, IECH, FIHD, ABEF, FECD, AGHD, GBCH and GBCH. One more rectangles is JKLM. Therefore, there are total 10 rectangles.



Hence, the correct option is (C).

18. (D)

Given : An opaque cylinder is suspended in the path of a parallel beam of light such that its shadow is cast on a screen oriented perpendicular to the direction of light beam.

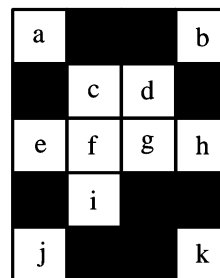
The cylinder can be reoriented in any direction within the light beam. Under these conditions shadow S is not possible.

Hence, the correct option is (D).

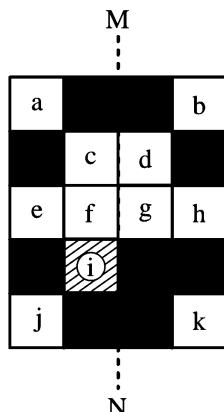
19. (B)

Given : A line of symmetry is defined as a line that divides a figure into two parts in a way such that each part is a mirror image of the other part about that line.

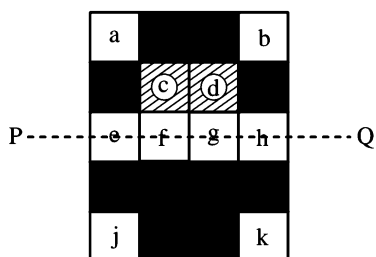
The figure below consists of 20 unit squares arranged as shown. In addition to the given black squares, upto 5 more may be coloured black.



In the figure given below, MN is the vertical line of symmetry for the figure, for which we have to colour the box 'i'.



In the figure given below, PQ is the horizontal line of symmetry for the figure, for which we have to colour box 'c' and 'd'.

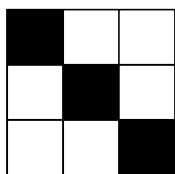


Therefore, we have to colour 3 boxes c, d, i to achieve two line of symmetry MN and PQ.

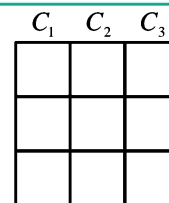
Hence, the correct option is (B).

20. (D)

Given : Cells of 3×3 grid are to be shaded such that each row and each column have exactly one shaded cell. An example of one valid shading is given below,



On the basis of the example, let's take a 3×3 grid.



In column C_1 there are 3 ways to shaded a cell and with reference to the condition, for column C_2 there will be 2 ways to shaded a cell and in column C_3 there will be only 1 way to shaded a cell.

Hence, total number of ways will be $3 \times 2 \times 1 = 6$ Such that each row and each column have exactly one shaded cell.

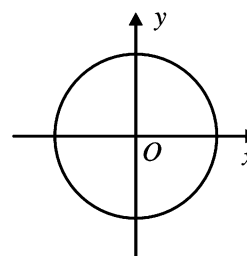
Hence, the correct option is (D).

21. (A)

Given : A circle with its centre at the origin (O) as shown two operation are allowed on the circle.

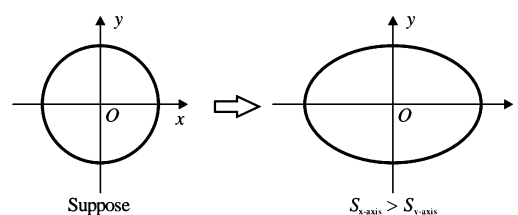
Operation 1 : Scale independently along the x and y axes.

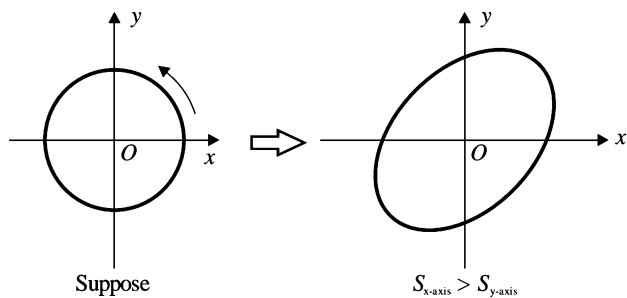
Operation 2 : Rotation in any direction about the origin.



Through a combination of these two operations on the given circle we can find the figure given below :

Operation 1 :



Operation 2 :

Hence, the correct option is (A).

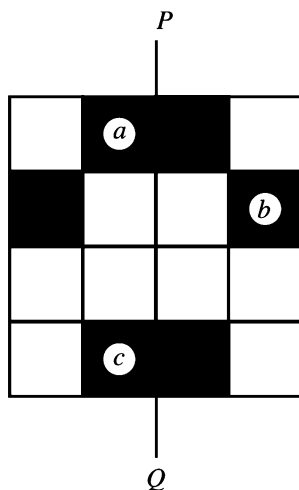
22. (C)

Given : The figure consists of 16 unit squares.

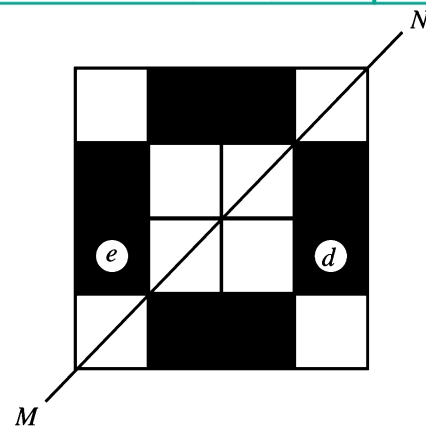
In addition to three block squares, the minimum number of squares that must be colored black, such that both PQ and MN form lines of symmetry, can be found as per the procedure.

Draw diagram given in question on

First of all we make PQ the line of symmetry and for this we need three more black squares (a, b, c) as shown in the given below figure.



Second one we will make this figure symmetric with MN, for that we need two more block squares (d, c) as shown in the given below figure.



The minimum numbers of squares that must be coloured black are 5, such that both PQ and MN forms line of symmetry.

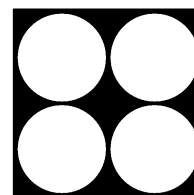
Hence, the correct option is (C).

23. (D)

Given : A flat plane, which has to be completely cover by repeating a particular shape tile extending to infinity in all directions, without leaving any empty spaces in between them.

Also the copies of the shape used to tile are identical and are not allowed to overlap.

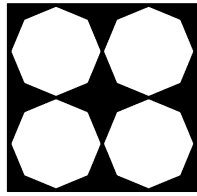
For fulfilling this condition, let's start with the option (A) circle, and tile it on a plane, as shown in below figure,



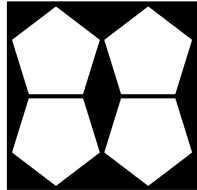
We can clearly see from the figure, if taking a circular tile for covering a flat plane there will be some remaining space, which will not be covered.

Now let's take option (B) regular octagon, and tile it on the flat plane as shown in figure.

We can clearly see from the figure, if taking a regular octagon tile there will be some remaining space, which will not be covered.

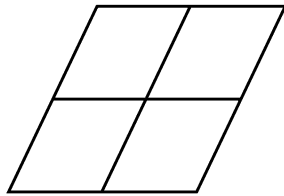


Now let's take option (C) regular pentagon, and tile on the flat plane as shown in the figure.

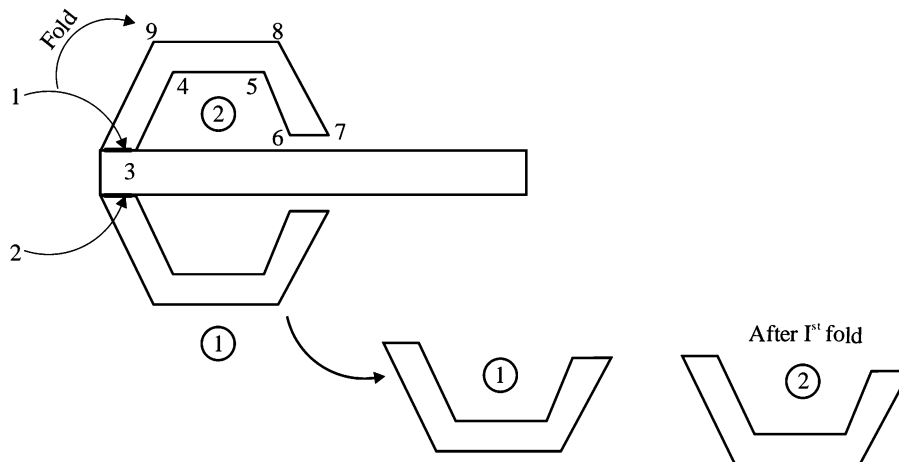


We can clearly see from the figure if taking a regular pentagon there will be some remaining space, which will not be covered.

Now let's take option (D) rhombus, and tile it on the flat plane as shown in the figure.



26. (A)

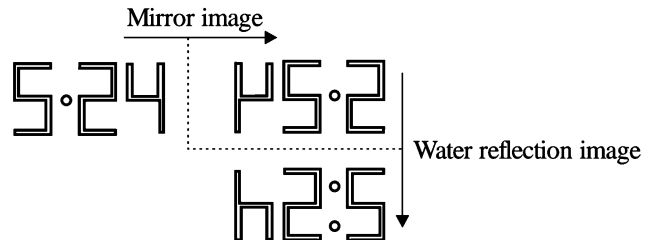


We can clearly see from the figure that there is no free space remaining on the flat plane.

Hence, the correct option is (D).

24. (A)

Given :

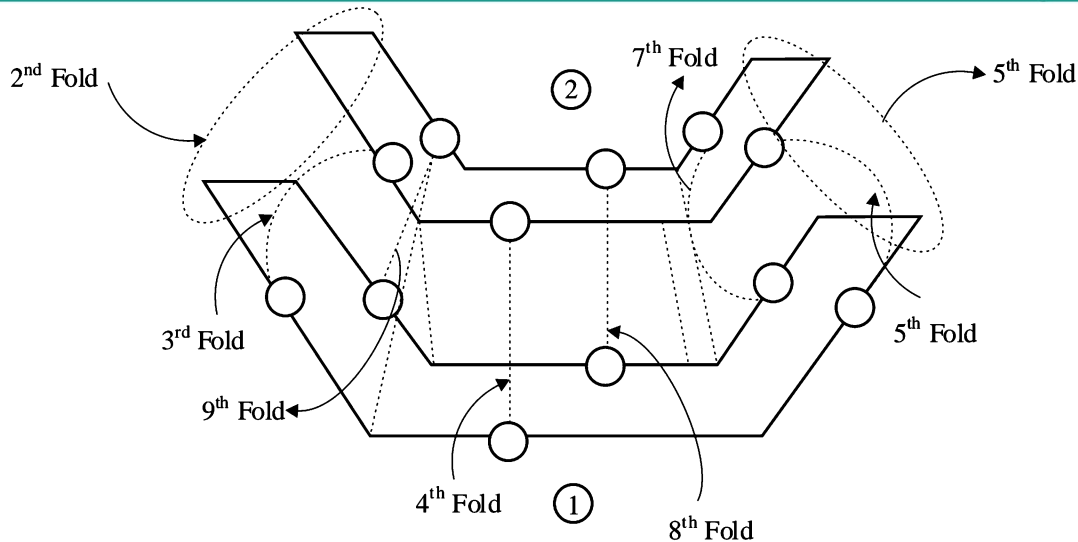


Hence, the correct option is (A).

25. (A)

From the given diagram, if viewed from direction y, the planar image of the assembly (Figure A) will appear as the figure given in option (A).

Hence, the correct option is (A).



Total 9 folds required to form the given objects.

Hence, the correct option is (A).

27. (A)

Given : Figure of squares and line of symmetry is shown in figure below.

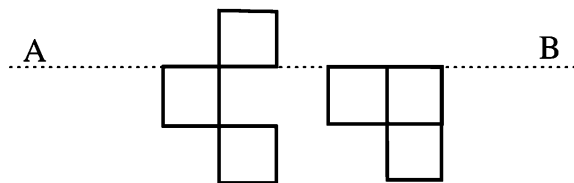


Fig.(a)

The least number of squares to be added in fig.(a) to make AB a line of symmetry is represented by dotted lines as shown in fig.(b).

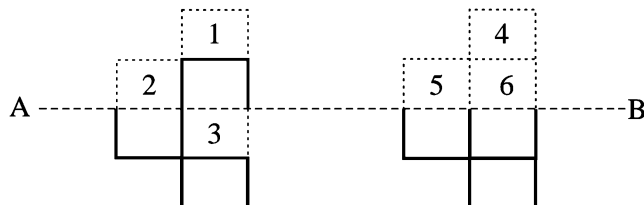
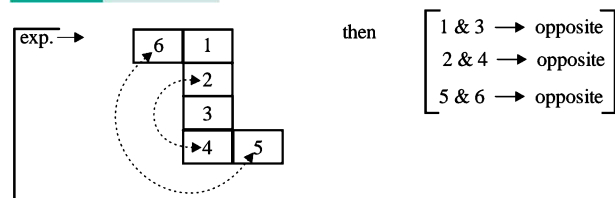


Fig.(b)

Hence, the least number of squares to be added in figure to make AB a line of symmetry is 6.

Hence, correct option is (A).

28. (A)

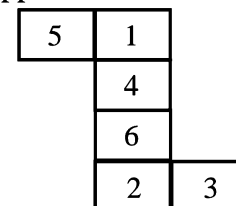


Ist view : Opposite face of 4 is either 2, 3 & 6.

IInd view : Opposite of 4 cannot be 3 & 6.

Opposite of 5 is either 3 or 6.

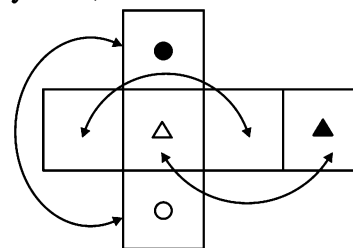
IIIrd view : Opposite of 5 cannot be 6.



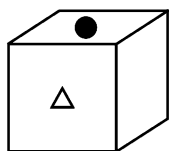
Hence, the correct option is (A).

29. (A)

The given paper consists of six square, each with different symbol, when folded into a cube.



- The black dot and the triangle will be adjacent.
- The circle will opposite to the face containing the black dot.

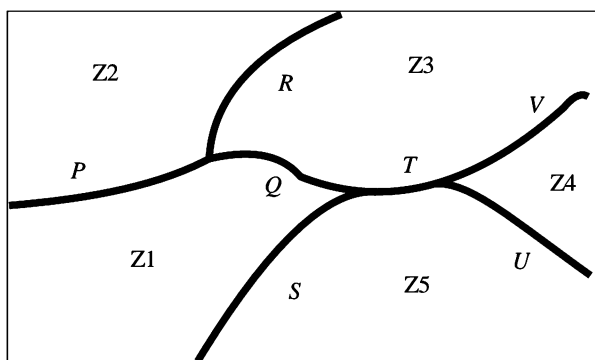


Hence, the correct option is (A).

30. (C)

Given : River system consists of 7 segments P, Q, R, S, T, U and V

The seven segment splits the land into 5 zones Z_1, Z_2, Z_3, Z_4, Z_5



From option (A) : Bridges on P, Q and T does not connect the zone Z_4 . Hence, all 5 zones are not connected.

So, option (A) is not correct.

From option (B) : Bridges on P, Q, S and T does not connect the zone Z_4 .

So, option (B) is not correct.

From option (C) : Bridges on Q, R, T and V connects all the 5 zones and are least number of bridges required to connect these zones.

So, option (C) is correct.

Form option (D) : Bridges on P, Q, S, U and V connects all the 5 zones but are not the least number of bridges required to connect these zones.

So, option (D) is not correct.

Hence, the correct option is (C).

31. (B)

The given problem presents a sequence of circular figure, each divided into a shaded and unshaded region.

In figure 1 : The circle is divided into two equals halves, with the left half shaded.

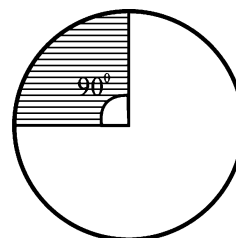
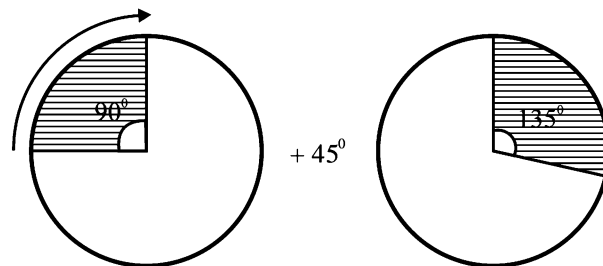
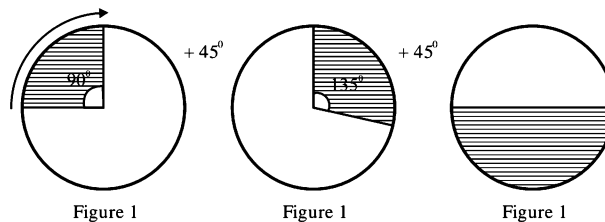


Figure 1

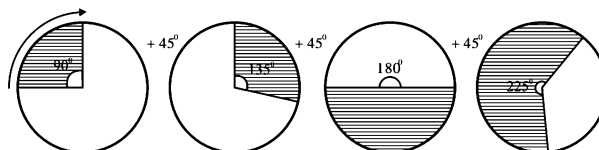
In figure 2 : The shaded portion is rotated 90° clockwise.



In figure 3 : The shaded portion is further extended by 45° while maintaining the same rotation pattern.



In figure 4 : The shaded region will continue to rotate 90° clockwise and extend further by 45° .

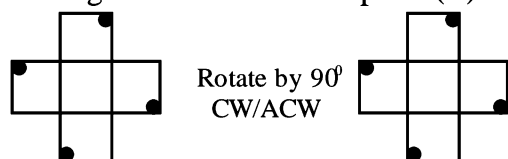


Hence, the correct option is (B).

32. (B)

n-fold rotational symmetry if the object is rotated by $\frac{2\pi}{n}$.

4-fold rotational symmetry for $\frac{2\pi}{4} = \frac{\pi}{2}$ angle by rotating the given options by 90° CW/ACW the identical figure is obtained for option (B).



Hence, the correct option is (B).

33. (B)

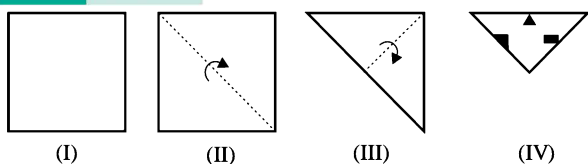
Reflection about the Horizontal dashed line

- (i) Reflection inverts the image vertically
- (ii) The top part moves to the bottom and vice-versa
- (iii) The left and right direction remain unchanged

Rotation by 90° clockwise

- (i) After reflection, the entire figure is rotated clockwise by 90°
 - (ii) The elements shift positions accordingly
- After performing both transformations, the correct figure matches option (B).

Hence, the correct option is (B).

34. (A)

1. Figure (i) : A square sheet of paper.
2. Figure (ii) and (iii) : The paper is folded diagonally into smaller triangles.
3. Figure (iv) : Small cuts are made in the folded paper.

Since, the cuts are made on the folded paper,

when it is unfolded, the pattern will be symmetrically distributed around the paper.

We can conclude that after unfolding the pattern in option (A) is obtained.

Hence, the correct option is (A).

35. (D)

Option (d) is correct because its 3D structure produces the same L-shaped front view with a taller left column and lower right extension.

Its top view exactly matches the given L-shaped block arrangement without any extra or missing blocks.

Hence, the correct option is (D).

36. (A)

Given : Four puzzle pieces are to be used exactly once without overlap.

Observe the pieces :

- One piece has a curved semicircular cut → this must form the circular head.
- One piece has a pointed triangular extension → this must form the beak.
- Two pieces have matching zig-zag edges → these fit together to form the neck/body junction.
- In Q, there is no pointed beak.
- In R, the lower body shape cannot be formed using the given slant-edged piece.
- In S, the top projection does not match any of the given pieces.

Only P uses :

- The curved piece as the head,
- The pointed piece as the beak,
- And the remaining two pieces join correctly to form the body.

Therefore,

Required figure = P

Hence, the correct option is (A).

